Demand Access System Requirements Specification (DASRS)

February 25, 1999

National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

Demand Access System Requirements Specification (DASRS)

February 25, 1999

Initiated by: _____

TBD
Demand Access Project Manager
Code 450

Approved by: _____

TBD
Demand Access Project Manager
Code 450

Preface

This document was produced for the MO&DSD Networks Division, Code 450, and will be controlled by the Demand Access Program Manager.

Any questions or comments regarding this document should be addressed to:

Demand Access Project Manager
Code 450
Goddard Space Flight Center
Greenbelt, Maryland 20771

TABLE OF CONTENTS

1. Introduction

1.1 Background

Conventional Tracking and Data Relay Satellite System (TDRSS) operations provide the Space Network (SN) user with service based on a schedule generated from user requests. Normally completed days in advance, this schedule is based upon estimates of user needs and mission event timelines. The need to provide timely SN service to smaller missions and at a reduced cost makes a more efficient service allocation more desirable. The Demand Access System (DAS), provides automated service-on-demand. This benefits not only the SN user, but also the SN itself, with low implementation cost and no change in the existing TDRSS-spacecraft. The TDRSS Multiple Access (MA) service was selected for Demand Access (DA) support for the following reasons:

- it supports multiple users simultaneously,
- it is low cost alternative to providing more TDRSS service time, and
- it makes better use of the underused MA service resources.

1.2 Document Description and Scope

The Demand Access System Requirements Specification (DASRS) is an intermediate level (B level) requirements specification that would have been ideally derived from the analysis of high-level (A level) specifications. However, no high-level requirements specifications document has been produced for the DAS. Without having this source of system requirements, it has become necessary to use existing sources of system description and operations concepts documentation to derive high-level requirements that fill the role of the missing DAS high-level system specification. The Demand Access System Description and Operations Concept (DASDOC) document contains a summary of all of the technical information produced thus far concerning the DAS. Therefore, the DASDOC has been used as a starting point to identify high-level requirements that are a basis for producing DASRS. As shown in Figure 1-1, the DAS requirements process extraction yields a high-level list of system specifications that can be divided into the following four categories:

- architecture,
- functions,
- operations, and
- interface requirements.

The first three categories serve as a basis for developing the DASRS. Since a Demand Access System Interface Control Document (DASICD) is being developed in parallel with the DASRS, the last category (interface requirements) has been relegated to the interface control document. Figure 1-1 shows the main structures of both the DASRS and the DASICD. The contents of each requirement section in both documents are summarized in Figure 1-1.

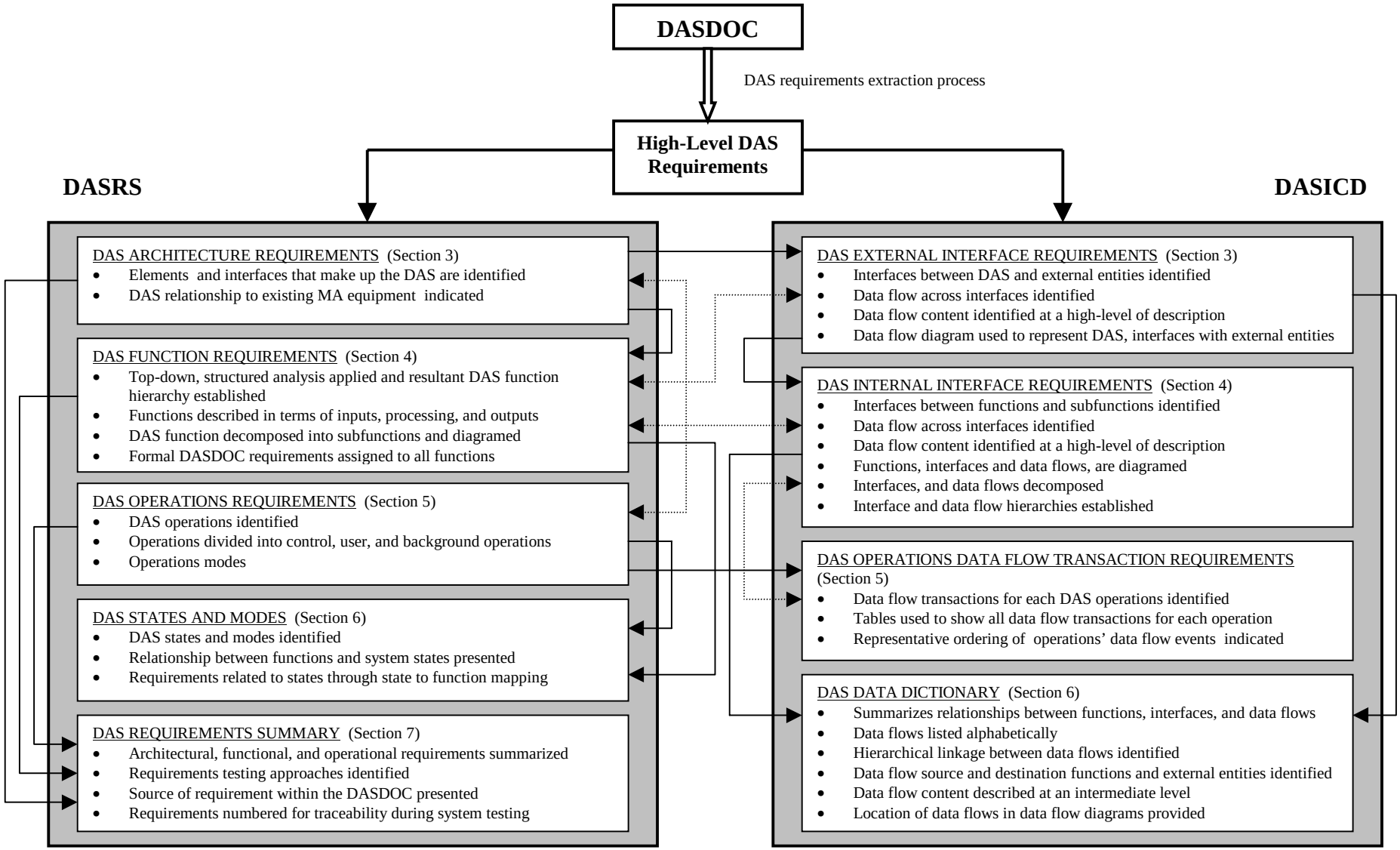

Figure 1-1 DAS Requirements Origins, Analysis Relationships, and Document Organization

Since the four categories of requirements are all interdependent from a system perspective, the analysis of the high-level specifications cannot be isolated in producing each of the requirements sections in the DASRS and the DASICD. The arrows in Figure 1-1 indicate the dependencies between the four requirement categories within each document and between the documents. Solid one-way arrows indicate that information presented in a given section strongly governs what appears in the section to which the arrow is pointing. Dotted two-way arrows indicate that the information in both sections to which the arrowheads are pointing is tightly coupled. Tightly coupled sections require mutual, iterative development during the analysis stage in order to meet all of the objectives of the high-level requirements. In particular, Figure 1-1 indicates that tight requirements coupling exist between the functional requirements section of the DASRS and the external and internal interface requirements sections of the DASICD. This reflects the fact that changes in either the function requirements or the interface requirements of a system cannot in general occur without impacting the compliment member of the pair.

Tight coupling exists between the architectural and operational requirement sections within the DASRS. This is evident from the fact that the architecture of the system must be tailored to allow the operations requirements to be met. In general, the operational characteristics are constrained by the system architecture.

Lastly, tight coupling exists between the operational requirements and the data flows of the DASICD. In order to implement an operational capability, the data flows must be able to convey the information needed by the functions of the system that support DAS operations.

In addition to the contents of the requirements presentation Sections 3 through 7 of the DASRS shown in Figure 1-1, this document also contains the following non-requirements sections:

- Introduction: Section 1 describes the scope and organization of this document as well as applicable documents
- DAS Overview: Section 2 of the document briefly describes the architecture, services, high-level scheduling aspects, and functional building blocks associated with the DAS.
- Acronyms and Abbreviations: Section 8 contains a list of all of the acronyms and abbreviations used in this document.

Since the DASRS is an intermediate level requirements specification, functions have not been decomposed to the lowest level (C level). Low–level requirements analysis will proceed by taking the lowest-level functions presented in Section 4 of this document and further decomposing them to a level that is commensurate with the low-level modular aspects of the design implementation of the system. This level of function decomposition will occur in a detailed DAS requirements specification that will follow in a later stage of the DAS project.

1.3 Applicable Documents

The following documents were used as general references in the preparation of this document.

- Demand Access Project Plan, Version 1.1, February 1998.
- Demand Access System Description and Operations Concept (DASDOC), Version 1.3, February 1999.

- Specification for the Third Generation TDRSS MA Beamforming Subsystem Prototype Controller, Version 6.2, February 1999.
- Interface Control Document for the Third-Generation TDRSS MA Beamforming Subsystem, Revision 5.4, December 1998.
- Software Design Document (SDD) for the Demand Access (DA) Planning Tool, Revision 1.3, May 19,1998.
- Demand Access System Interface Control Document (DASICD), Version 1.1, February 1999.

2. DAS Overview

This section contains a brief description of the DAS architecture and the allocation of the architectural elements in establishing and using DAS services. A detailed description of these topics can be found in the DASDOC.

2.1 DAS Architecture

Figure 2-1 shows the functional architecture of the DAS. The existing TDRSS elements that form the foundation for the DAS are also shown in this figure. The systems that augment the existing MA system to form the DAS appear as shaded function blocks and are as follows:

- Third Generation Beam Forming System (TGBFS),
- DA Return Link Data Recovery Subsystem (RLDRS), and
- DA Control/Data Handling Subsystem (DACDHS).

While the TGBFS and RLDRS are integral parts of the DAS, they are hardware entities that exist by themselves and are being developed independent of the DAS. The design of the DAS assumes that these systems will be present for integration with the DACDHS. Requirements assigned to the TGBFS and RLDRS in this document underline the expectations of the TGBFS and RLDRS capabilities in terms of their role relative to the objectives of the DAS.

Current plans are to have two DASs at the WSC to provide front side TDRSS satellite coverage for DAS User service requests. Backside TDRSS satellite coverage will be realized by a DAS installed in the SGLT located at Guam.

DAS Users, the Network Control Center (NCC), and the Flight Dynamics Facility (FDF) will communicate with the DACDHS through the Closed Input/Output network (IOnet). The DACDHS will orchestrate the implementation of requests for

- Demand Access Forward (DAF) services with the NCC, and
- Demand Access Return (DAR) services by configuring the TGBFS and RLDRS according to DAS User service request specifications.

Section 4 of this document analyzes the iterative decomposition of the DACDHS into subordinate functions and describes in detail the processing requirements of each function.

Forward link DAS services will use the existing MA Forward Service Chain in the Space Ground Link Terminal (SGLT). DAS User data and commands will be sent via the Closed IOnet to the DACDHS for buffering. The buffered commands and data will be sent to the forward equipment chain from the DACHDS through the Control/Data Interface for uplinking to the User Platform (UP).

Return link DAS services will use the existing MA Return Service Chain for the front-end Radio Frequency (RF) processing. The TGBFS will accept the Intermediate Frequency (IF) signal

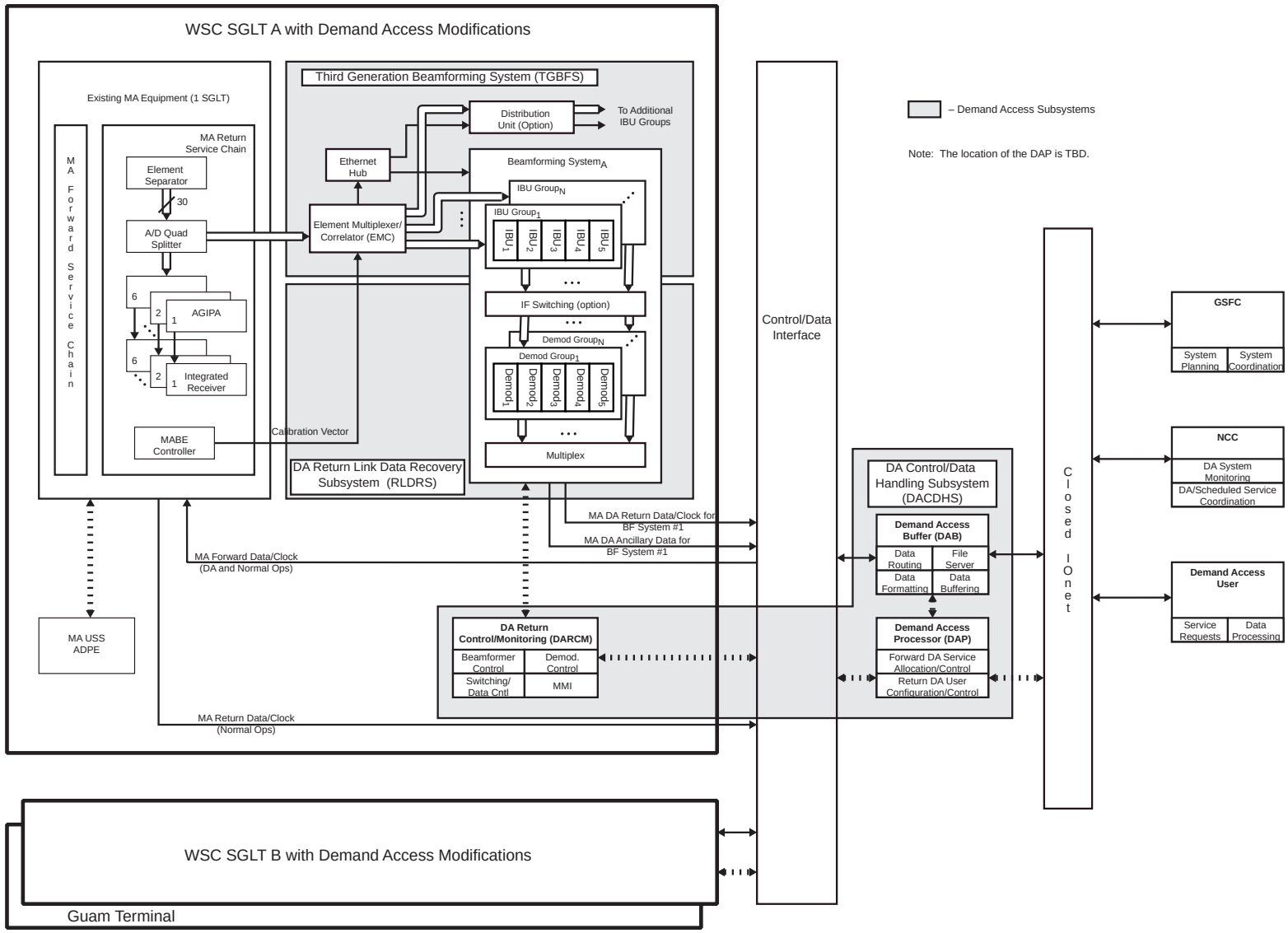

Figure 2-1 DAS Functional Architecture

message data from the signal based on Pseudorandom Noise (PN) code discrimination. The RLDRS will forward the message data to the DACDHS for formatting, buffering via the Control/Data Interface. The DACDHS will route the return data to the DA User via the Closed IOnet.

2.2 Implementing and Using DAS Services

The DAS provides TDRSS users with the capability of obtaining TDRSS services on demand. Two types of DA services are available: DAF and DAR services. The following section describes both of these DA services. Refer to Figure 2-1 for an architectural perspective of the location of the DAS functions described in the following sections.

2.2.1 DAF Service

The TDRSS Unused Time (TUT) for the MA system that is determined daily by the NCC forms the basis for the times when DAF services can be allocated. This information is supplied to the DAP function in the DAS. The FDF supplies the DAP function with updated satellite state vectors for use with the TUT schedules in determining UP visibility constraints. One DAF service per TDRS satellite can be implemented at a time due to the constraints of the existing Multiple Access Forward (MAF) system.

Figure 2-2 shows the DAS functions and operations required to establish a DAF service. The following numbered paragraphs correspond to the sequence of steps shown in Figure 2-2 that outline the activities associated with the allocation and use of the DAF service.

1. DAS Users make requests for DAF services based on information obtained from the DA Planning Tool situated in their Project Operation Control Centers (POCCs). The requests are sent to the Demand Access Processor (DAP) which assesses them to ensure that the requests remain within the constraints of available TUT and satellite visibility. The DAP function notifies the Demand Access Buffer (DAB) function that the DAF service is being requested and supplies it with the specifications for handling the commands and data to be forwarded to the UP. DAS User commands and data are forwarded to the DAB function for buffering.

2. The DAP function forwards the specifications for valid DAF requests to the NCC.

3. The NCC commands the appropriate SGLT to configure the existing MAF equipment chain in accordance with the DAF specifications.

4. During the time interval when the service is operational, the DAB forwards the buffered data to the SGLT MAF equipment chain at the time(s) designated in the DAF service specification for uplinking to the UP. Real-time user commands and data are forwarded directly to the MAF equipment chain for immediate uplinking to the UP during DAF service time interval.

5. DAS User commands and data are uplinked to the TDRSS satellite.

6. The TDRSS satellite forwards the commands and data to the UP.

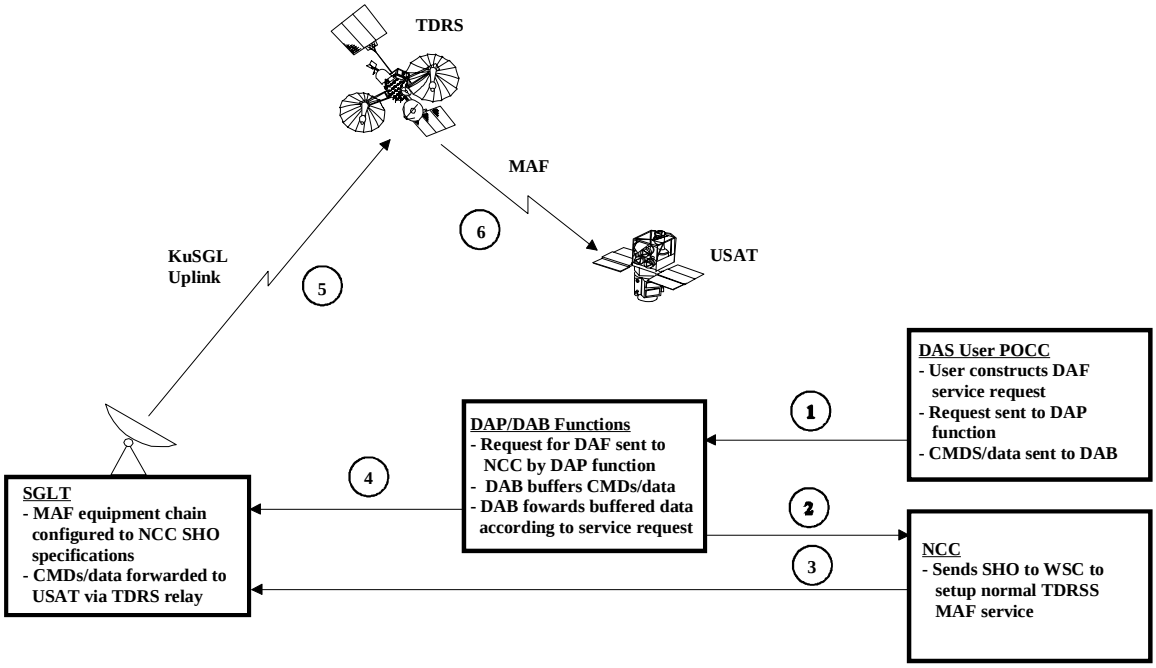

Figure 2-2 Establishing and using a DAF Service

2.2.2 DAR Services

Multiple DAR services can be established simultaneously. The upper limit on the number of DAR services is determined by the number of beamformer equipment modules installed in the TGBFS function and the number of demodulators present in the RLDRS function. A practical upper limit of 50 simultaneous DAR services exists when the modular expansion of the beamformer and demodulator equipment reaches the limit of current design capacity.

Figure 2-3 shows the DAS functions and operations required to establish a DAR service. The following numbered paragraphs correspond to sequence of steps shown in Figure 2-3 that outline the activities associated with the allocation and use of the DAR service.

1. DAS Users construct DAR requests based on information obtained from DA Planning Tool. The requests are forwarded to the DAP function for validation and implementation. The DAP coordinates the implementation of the service by providing the DAB function with service specifications for return data buffering, formatting, and routing.

2. The DAP function provides the service setup specifications to the beamforming and demodulator controllers as part of the DAR service implementation process.

3. S-band signals from the UP are received by the TDRSS satellite where they are upconverted to Ku-band for transmission to the SGLT.

4. The existing Multiple Access Return (MAR) equipment chain converts the RF signal to IF and forwards the 30 channels of digitized return signal to the DA beamformers along with the calibration vector.

5. The beamformer spatially isolates the return signal based on the information provided by the beamfomer controller.

6. The spatially isolated signal is processed by a demodulator which extracts the correct UP data from the IF signal stream by PN code discrimination. The DAB function formats and buffers the data.

7. The DAB function routes the return data to the DAS User.

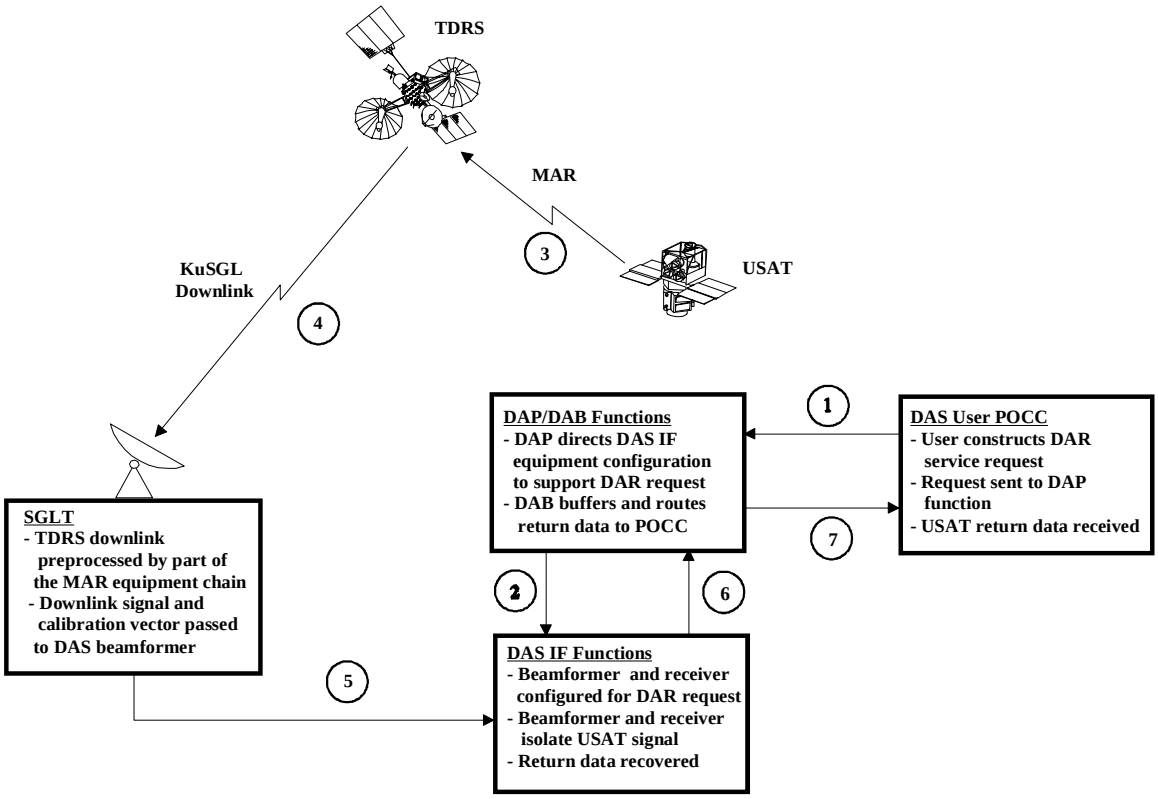

Figure 2-3 Establishing and using a DAR Service

3. DAS Architectural Requirements

Table 3-1 contains the formal architectural requirements for the DAS. The DAS architectural requirements presented in this table were extracted from the DASDOC. The first column in the table contains the DAS requirement number. The second column contains the section number in the DASDOC from which the requirement was extracted. Each requirement is presented in terms of a sentence containing the verb "shall". Sentences not containing the verb "shall" are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. The third column contains the requirement. Figure 2-1 should be consulted for a pictorial presentation of the DAS architectural physical features described in the requirements. Another version of the information presented in the table, with additional cross-referencing and requirements testing information, is presented in Section 7.

Table 3-1 DAS Architectural Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
6	3.1	The elements that augment the existing MA system to form the DAS shall be: • Third Generation Beam Forming System (TGBFS) • DA Return Link Data Recovery Subsytem (RLDRS) • DA Control Data Handling System (DACDHS) Function
7	3.1	Unlike the current beamforming system (constrained to support a maximum of five simultaneous MAR users per TDRS satellites), the TGBFS shall be capable of being continually expanded to accommodate a potential increase in the number (up to 50) of simultaneous DAS return service users.
8	3.1	The capability of modularly increasing the number of beamformers in the DAS design shall be coupled with the parallel capability of increasing the number of demodulators required to extract the data from each additional user's return signal.
9	3.1	The TGBFS and the RLDRS shall operate in conjunction with the existing MAR service chains located in each SGLT to support DAR services.
16	3.1	The Closed Nascom IP Operational Network (IOnet) shall be used to transfer service request information, commands, and data between the DAS User and the DAP and DAB functions.
32	3.2.1.1	The DAF service shall use the existing SGLT MAF equipment.
57	3.4	The elements of the DAS consist of the existing functions of the TDRSS MA services and the new DA functions that shall be added to support DA operations.
39	3.2.1.2	The upper limit on the number of DAR users shall be determined by the number of DA beamformers and demodulators present in the SGLT.

Table 3-1 DAS Architectural Requirements (Continued)

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
40	3.2.1.2	Increasing the number of beamformers and demodulators in the TGBFS and DA RLDRS, respectively, shall increase the size of the equipment pool from which DAR service equipment chains can be constructed for simultaneous DAR users.
41	3.2.1.2	There shall be two categories of DAR equipment: • dedicated equipment consisting of beamformers and demodulator owned by specific DAS Users, and • equipment consisting of a pool of NASA supplied beamformers and demodulators that are shared by DAS Users.
42	3.2.1.2	The DAR service shall use some existing MAR and new DAS SGLT equipment.
53	3.3.2	DAS Users shall have a choice to install their own dedicated DAR beamforming and demodulator equipment.
56	3.3.2	DAS Users shall be capable of routing their own data independent of the DAB.
74	3.4.2	The DAR implementation (software augmentation to the current WSC and Guam SGLT infrastructures) shall require development and deployment of new hardware.
75	3.4.2	Return DA shall accommodate up to 50 users. Depending on the number of users, each user may be provided continuous service via a dedicated, rather than demand access service.
76	3.4.2	TDRSS MAR antenna beam tracks user spacecraft, thus providing the opportunity for user spacecraft to return data any time they are in view of a TDRS. If three widely spaced TDRSs are used, continuous coverage can be provided. A key requirement for this approach shall be that enough beamformers and demodulators be available at WSC to serve all DA Users. Since WSC equipment chains are dedicated to each TDRSS spacecraft, the possibility of an uneven distribution of users in view to a specific TDRSS spacecraft means that the total number of required beamformers and demodulators exceeds the number of users.
78	3.4.2	The key elements/functions (refer to Figure 3-1 of DASDOC) of the DAR architecture shall be as follows: • TGBFS Function • RLDRS Function • DA Control/Data Handling System (DACDHS) Function
85	3.4.2.2	The RLDRS shall consist of at least the following elements (demodulators and a multiplexer) needed to recover the MAR link data after beamforming.
109	3.4.3	The DA Planning Tool Function shall reside in the DA User's operations center.

4. DAS Function Requirements

This section describes the functions and subfunctions that comprise the DAS. Structured analysis[1,2] is used to successively decompose the DAS Function into subfunctions and interfaces or data flows into component data flows. The decomposition process of structured, top-down analysis can be briefly summarized as follows:

- Represent the system as a single function, identify all of the external interfaces to the function, and label the data flows across each interface
- Decompose the system function into subfunctions that interact with each other to produce the same resultant effect as the original function
- Identify the interfaces and data between subfunctions that are internal to the function
- Decompose any external interfaces to the function that share information between subfunctions and label the data flow components
- Maintain the fidelity of the decomposition results with the parent function by conserving the function processing, interface, and data flow information between the single function and its representation as a set of subfunctions
- Repeat the above decomposition process for each of the subfunctions to generate yet another lower-level set of subfunctions, interfaces and data flows while maintaining the fidelity of the relationship between subcomponents and the component from which they are derived
- Proceed with the recursive analysis method from the top-level system function to the lowest level subfunctions, interfaces, and data flows that satisfies the degree of system resolution required by the structured analysis goals
- Each of the subfunctions, interfaces, and data flows become requirements for the system

The Data Flow Diagram (DFD) is used to visualize the relationship between functions, interfaces and data flows. Figure 4-1 is an example of a top-level DFD that exists prior to the application of the functional decomposition process. The following conventions are used in this document to construct all DFDs in the DASRS and DASICD:

- functions are represented as shaded octagons on the DFD,
- entities external to the DAS are represented by squares,
- external and internal interfaces to a function are represented by arrows connecting the functions with other functions and entities (other functions or external entities),
- data flows across the interfaces are identified by the labels attached to the arrows, and
- vertical right, circular cylinders are used to represent databases.

Since this document focuses primarily on system functions, architecture, and operations requirements, the decomposition of the function interfaces are not presented in detail. Section 4 of the DASICD addresses the interfaces and data flow requirements between the functions presented herein. Therefore, the reader desiring to obtain detailed information about the decomposition of the interfaces and data flows is directed to consult the DASICD. The DASRS

[1] E. Yourdon, *Modern Structured Analysis*, Yourdon Press, 1989.
[2] T. DeMarco, *Structured Analysis and System Specification*, Prentice Hall, 1979.

and the DASICD complement each other in the presentation of different aspects of the information that appears on the DFDs.

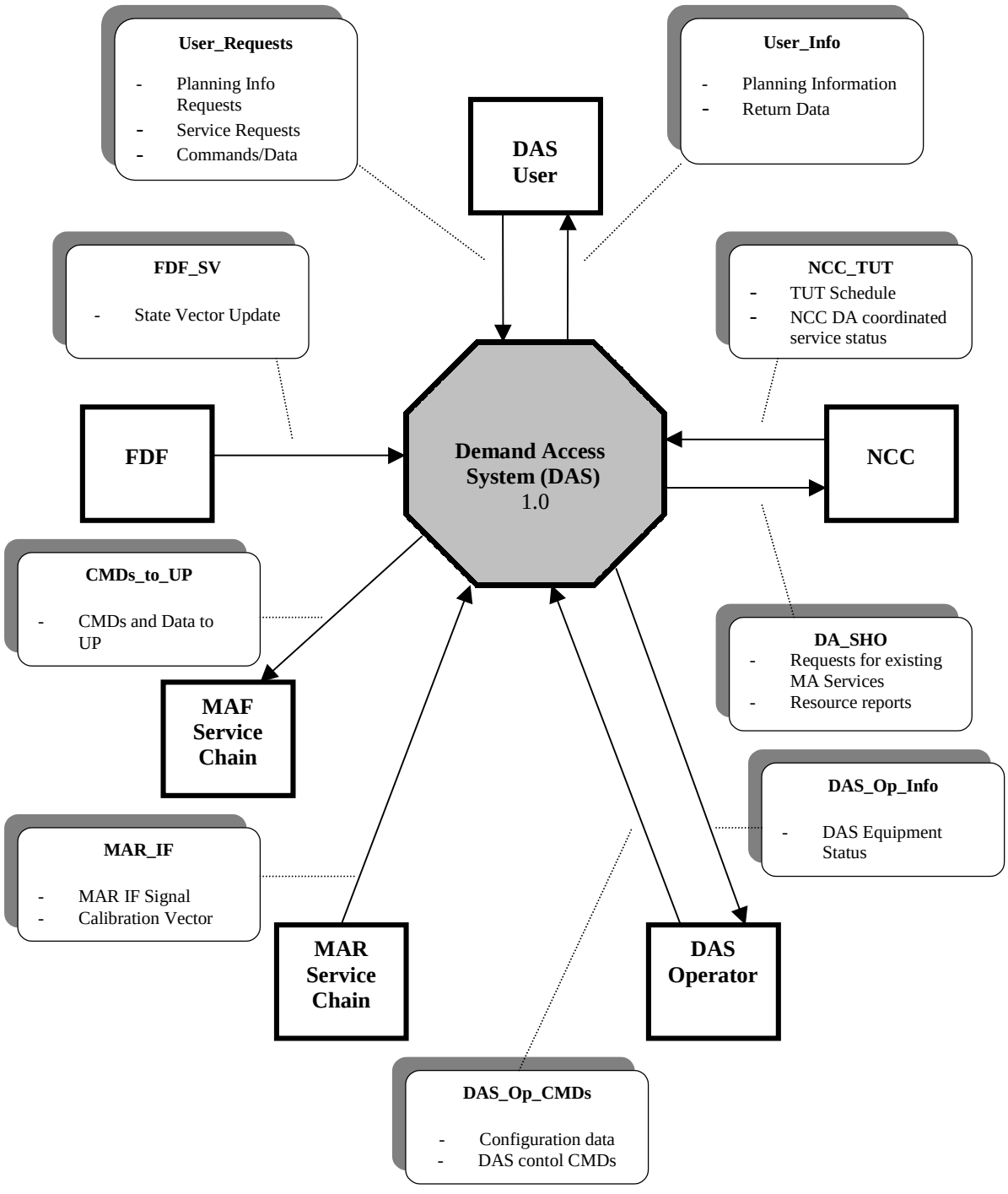

Figure 4-1 DAS Function (1.0) , External Entities, and External Interfaces

Figure 4-1 shows the DAS function and the external interfaces to the DAS. The DAS function is represented by the shaded octagon. The octagon characterizes the sum total of all of the DAS functions and subsystems shown in Figure 2-1. It is numbered 1.0 to designate that it is the top-level system function that exists prior to application of the DAS subfunction analysis described in Section 4.1. The DAS function interacts through external interfaces with the following entities:

- DAS User,
- DAS Operator (performs DAS start-up, termination, and system maintenance activities),
- NCC,
- FDF,
- MAF Service Chain, and
- MAR Service Chain.

Figure 4-1 shows the external entities as squares. The external entities are connected to the DAS function by arrows that designate external DAS interfaces. The direction of the arrows indicates the direction of data flow across the interfaces. Names are assigned to the data flows and a brief description of the data flow content is included in the rounded rectangular structures with a dotted line pointing to the relevant interface.

The individual functions that are described in each section represent a capability that the DAS is required to exhibit. Each function is presented in terms of

- purpose,
- inputs,
- processing,
- outputs, and
- function requirements.

The purpose segment serves as an introduction to the function by briefly describing the role that the function plays in the system. Input and output segments provide a high-level summary of the information contents of data flows entering and leaving the function, respectively. Each data flow is given a name on the DFDs and the names appear in the input and output segments with reference being made to the appropriate DFD. The processing segment describes the role of the function in terms of the data transformations associated with changing the function's input to output. In order to facilitate the understanding of the function processing, Structured English[3] is used as the means of information conveyance in describing the processing. The function requirements segment provides a formal description of the specific requirements associated with the function. Each requirement is assigned a unique identifier for traceability purposes during system testing. Each requirement is presented in terms of a sentence containing the verb "shall". Sentences not containing the verb "shall" are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC.

[3] E. Yourdon, *Modern Structured Analysis*, Yourdon Press, 1989.

The following paragraphs describe the DAS Function (1.0) in terms of purpose, inputs, processing, outputs and requirements.

Purpose - The role of the DAS Function (1.0) is as follows:

- Provide DAS Users with the information needed to make planning decisions to construct service requests,
- Provide DAS Users with the capability of requesting the allocation of DA forward and return services on demand, and
- Allocate DAS services in a timely manner while subjecting users to a minimum amount of service scheduling overhead.

Inputs - The following are the inputs (refer to Figure 4-1) to the DAS Function (1.0):

- DAS Users requests for service planning information or a DA service implementation (User_Requests)
- DAS User commands and data that will be uplinked to the UP during the DAF service (User_Requests)
- FDF state vectors for the TDRSS spacecraft and the USATs (FDF_SV)
- MAR service chain equipment IF signals (MAR_IF)
- MAR service calibration vectors (MAR_IF)
- DAS Operator system control request (DAS_Op_CMDs)
- NCC TUT schedule updates or status reports for NCC coordinated DA services(NCC_TUT)

Processing - The following is a description of DAS Function (1.0) processing:

For each DAS User, DAS Operator, NCC, FDF, and MAR Service Chain input, the DAS Function responds in the following manner:

If a request for service planning information is received from the DAS User, the function does the following:

- Respond to DAS User requests for service planning information with planning information reports derived from satellite visibility and resource availability analysis
- Support DAS Users with automated DA service planning information to lessen the users burden of decision making in setting up services

If the DAS User requests a DA service, the function does the following:

- Check to ensure that the DA service request specifications can be implemented
- Implement valid user requests for DAF or DAR service in the following ways:
  - If DAF request is being implemented, the function does the following:
    - Construct and send DA forward link service requests to the NCC for implementation as a MAF service
    - Transfer commands and data from the user to a UP according to DAF service request buffering and routing specifications
    - Send NCC coordinated DAF status reports to the DAS User

- If DAR request is being implemented with DAS equipment, the function does the following:
  - Configure the DAR equipment to accept MAR IF signals, demodulate the signal data, and distribute it to the DAS User
  - Accept IF signals and calibration vectors from the existing MAR service chain for DA beamformer processing to support more than 5 return link users simultaneously
  - Transfer data from a UP to a user according to DAR service request buffering and routing specifications
- If DAR request is being implemented with existing MAR equipment, the function does the following:
  - Construct and send DA return link service requests to the NCC for implementation as a DAR service using existing MAR service equipment
  - Transfer data from a UP to a user according to existing MAR service protocols
  - Send NCC coordinated DAR status reports to the DAS User

If a system control request is received from the DAS Operator, the function does the following:

- Transform SGLT DAS Operator requests for system control operations (start up, configure, terminate, and test) into the appropriate system responses
- Collect status information from the DAS components and display status reports for the DAS Users and operator

If TUT schedule or satellite state vector updates are received, the function does the following:

- Use TUT schedule updates for the satellite visibility assessments that support planning information and service requests
- Propagate satellite state vectors for the satellite visibility assessments that support planning information and service requests

Outputs - The following are the outputs (refer to Figure 4-1) from the DAS Function (1.0):

- Information for use by the DAS User to make requests for DA services (User_Info)
- UP data transferred to the DAS User during a DAR service session (User_Info)
- DAS User system status information (User_Info)
- DAS Operator DAS equipment operational and test status information (DAS_Op_Info)
- DAS requests to the NCC for MAF services (DA_SHO)
- DAS requests to the NCC for DAR services using existing MAR equipment (DA_SHO)
- Commands and data for uplinking to the UP (CMDs_to_UP)

Function Requirements - Table 4-1 contains a description of the formal processing requirements associated with the DAS Function (1.0) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb “shall”. Sentences not containing the verb “shall” are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-1 DAS Function (1.0) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
1	3.0	The DAS shall expand the capabilities of the current SGLT MAR beamforming system to handle an increased number (up to 50) of return service users beyond the current limit of five.
2	3.0	The MAR expansion shall be accomplished by the use of new beamforming equipment and the introduction of more demodulators to accommodate the increased TDRSS user load associated with the DAS.
3	3.0	DAS forward service allocation shall occur at those times when the NCC active schedule does not have MAF requests already occupying the scheduled time slots.
4	3.0	The DAS shall coordinate forward service requests with the NCC.
5	3.0	Return service requests shall be handled directly by the DAS, which controls the new beamforming and demodulator assets.
46	3.3.1	Service times shall be selected by the DAS for DAS Users with flexible service requirements.
58	3.4	The following functions shall support the DAS operations capabilities: • DAF Service Function • DAR Service Function • DA Planning Tool Function
67	3.4.1.1	The DAS shall set up DAF service by transmitting service requests to the NCC.
111	3.4.3	The Planning Tool shall provide a means of placing a DA scheduling request into the DAS.
149	4.3	DAS Control Operations shall provide the Master DAS Operator located at one WSC SGLT MMI with the capability to start up, configure, terminate, and test the portion of the DAS system that is related to that particular SGLT.
154	4.2.2	The SV updates shall be used by the DAS to calculate the periods of line-of-sight visibility between the user satellites and the TDRSs in order to support DA service schedule planning.

The following section contains the description of the subfunctions associated with the decomposition of the DAS Function (1.0).

4.1 DAS Function (1.0) Decomposition

An overview of the resultant function hierarchy derived via structured analysis is presented in Figure 4-2. Each function has an associated numeric identifier with it that shows its position in the function hierarchy in terms of its relationship with its parent function. For example, functions 1.2.1, 1.2.2, and 1.2.3 are all subfunctions of function 1.2. In addition, each function has a section number associated with it that designates its location within the structure of this document. The DAS Function (1.0) is unique in the sense that its location does not follow the same section derivation algorithm as its subfunctions. The DAS Function (1.0) is located at the beginning of Section 4.0. Subfunction section numbers are derived from the function identifier by prefixing 4 to the number. For example, the function numbered 1.3.2 will be described in detail in Section 4.1.3.2.

The following sections contain the subfunctions that combine to form the DAS Function (1.0) described in the previous section. Each subfunction is allotted one subsection below. The subsections contain the description of the following members of the DAS function:

- DA Planning Tool Function (Section 4.1.1)
- DACDHS Function (Section 4.1.2)
- TGBFS Function (Section 4.1.3)
- DA RLDRS Function (Section 4.1.4)

Figure 4-3 shows the results of decomposing the DAS Function (1.0).

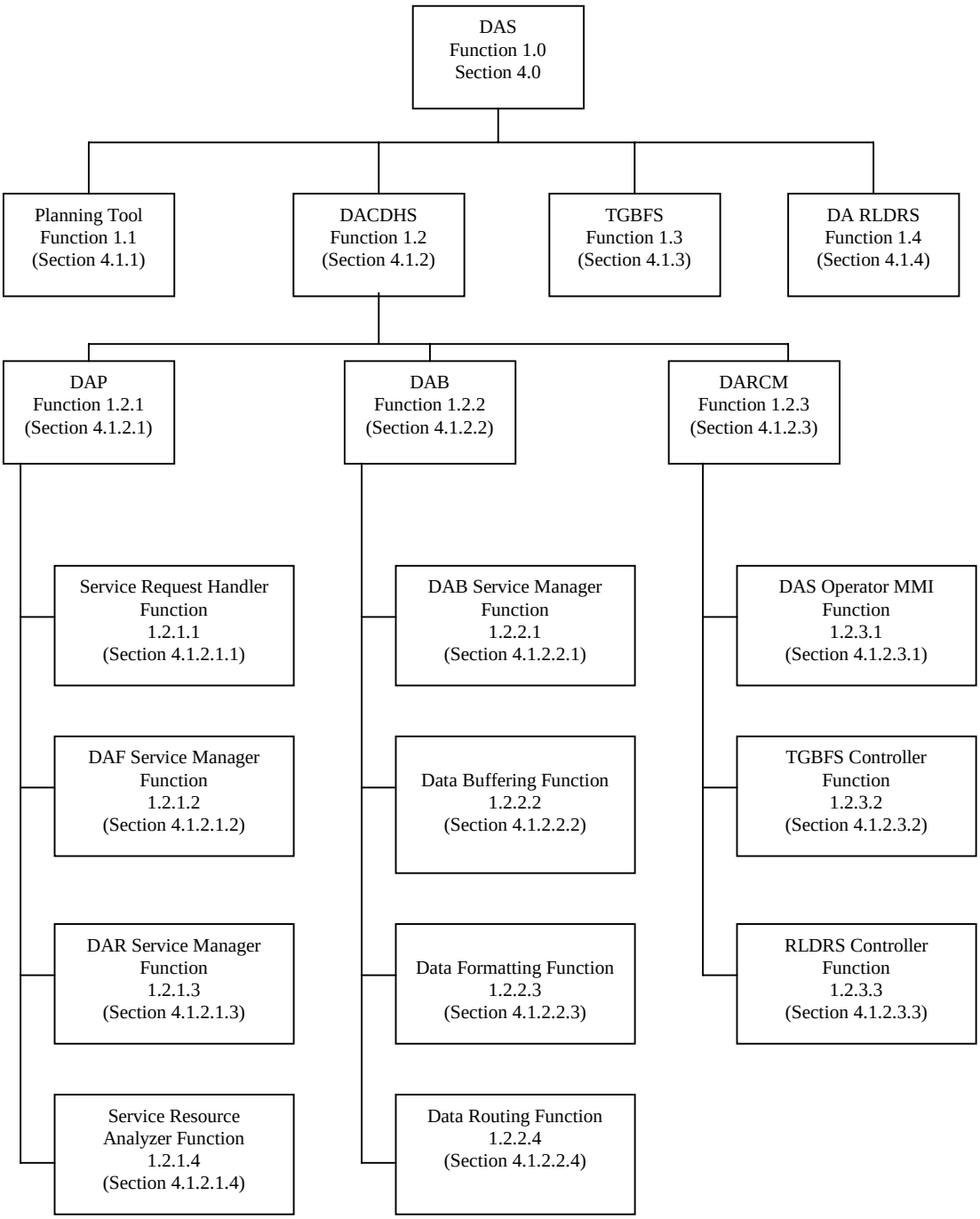

Figure 4-2 DAS Function Hierarchy and Function Description Location in the DASRS

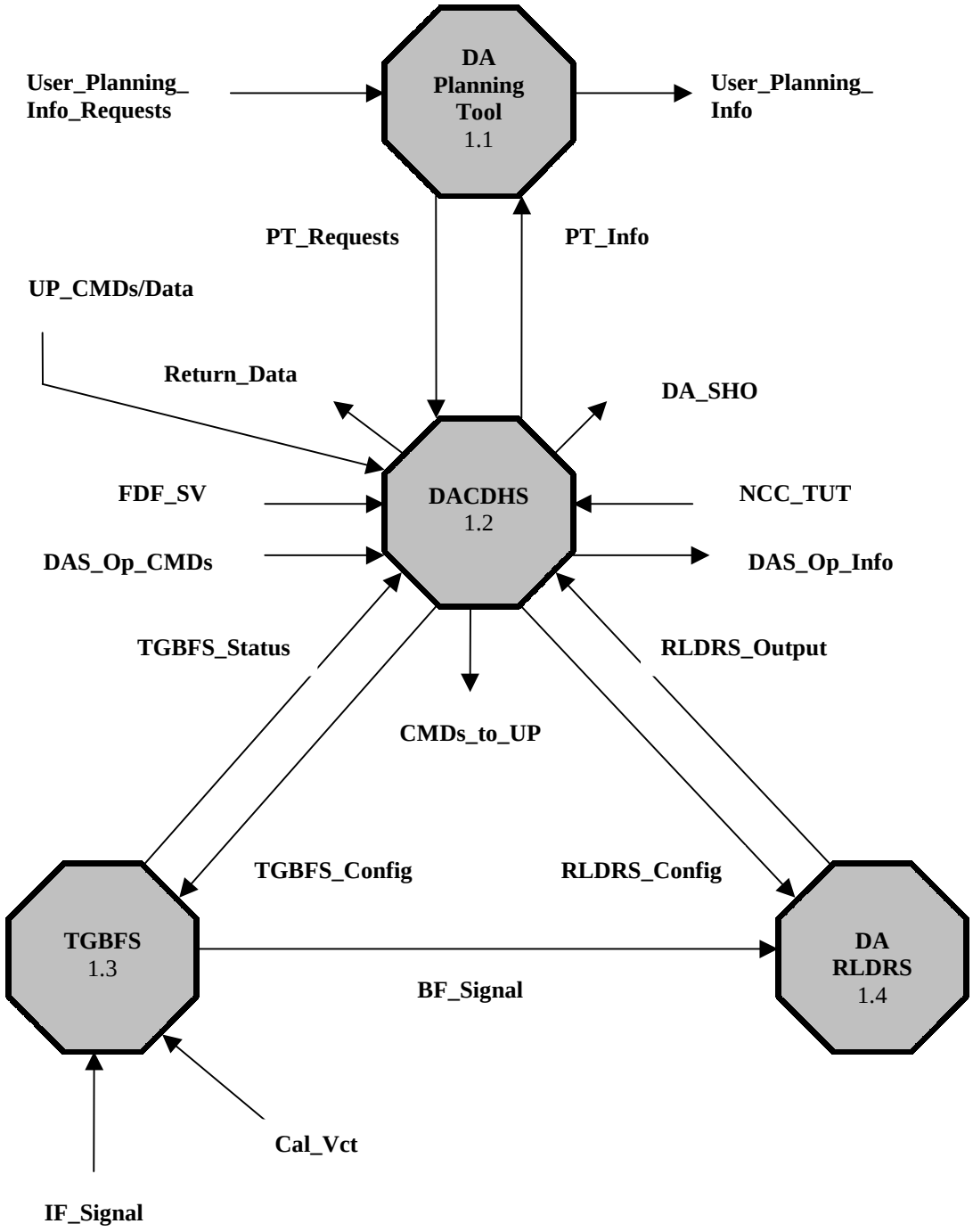

Figure 4-3 DAS Function (1.0) Decomposition DFD

4.1.1 DA Planning Tool Function (1.1)

Purpose - The role of the DA Planning Tool Function (1.1) is as follows:

- Provide the DAS User with information to make planning decisions based on spacecraft visibility and the availability of DAS service resources
- Enter user requests for DAS services into the system
- Enter optional user defined satellite visibility constraints for inclusion in service request assessment analyses
- Provide system performance monitoring status reports to the user

Inputs - The following are the inputs to the DA Planning Tool Function (1.1) (refer to Figure 4-3):

- DAS User service planning information requests in GUI representation (User_Planning_Info_Requests)
- DAS User service requests in GUI representation (User_Planning_Info_Requests)
- DAS User supplied satellite visibility constraints (User_Planning_Tool_Info_Requests)
- Service planning information response data in internal DAS representation (PT_Info)
- Service request status reports in internal DAS representation (PT_Info)
- System performance monitoring status information in internal DAS representation (PT_Info)

Processing - The following is a description of DA Planning Tool Function (1.1) processing:

For each DAS User request, the DA Planning Tool Function (1.1) responds in the following manner:

If a DAS User service planning information request is received, the function does the following:

- Transform planning information request data accepted from user friendly GUI forms and data files into internal DAS representation for transmission to the DACDHS Function (1.2)

If a DAS User service request is received, the function does the following:

- Accept DA service request data from user friendly GUI forms for internal DAS representation for use by the DACDHS Function (1.2)

If a report is received from the DACDHS Function (1.2), the function does the following:

- Accept system status reports indicating acknowledgements to user requests, service progress reports, DAS run-time performance monitoring reports from the DACDHS Function (1.2) and displayed for the DAS User
- Accept service request response data from the DACDHS Function (1.2) in internal DAS representation into report format that as reports for presentation on GUI forms
- Transform planning information request response data from the DACDHS Function (1.2) in internal DAS representation into report formats for presentation on GUI forms

Outputs - The following are the outputs from the DA Planning Tool Function (1.1) (refer to Figure 4-3):

- DAS User planning information request specification data messages in internal DAS representation (PT_Info)
- DAS User service request specification data messages in internal DAS representation (PT_Info)
- Planning information reports to DAS User in GUI representation (User_Planning_Info)
- Service request reports to DAS User in GUI representation (User_Planning_Info)

Function Requirements - Table 4-2 contains a description of the formal processing requirements associated with the DA Planning Tool Function (1.1) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb "shall". Sentences not containing the verb "shall" are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-2 DA Planning Tool Function (1.1) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
29	3.2.1.1	Users shall be guided through the selection process by means of the DA Planning Tool located at the user POCC that interfaces with the DAP.
110	3.4.3	The Planning Tool shall provide the DAS User with information to make decisions about DA service availability.
112	4.1.1.1	The DAS User shall interact with the Planning Tool's Graphical User Interface (GUI) during the planning session phase.
113	4.1.1.1	At the most basic level of operations, the user shall be presented with the time slots that remain available on the TUT schedule which is updated daily by the NCC.
114	4.1.1.1	The user shall be able to vary the level of flexibility of the scheduling requests derived from planning information from a completely flexible to highly specific request for DAS services.
115	4.1.1.1	The amount of complexity associated with the planning request shall depend in general upon GUI flexibility.
116	4.1.1.1	The DAS User accepts any available TUT slots for the purpose of uploading buffered commands and data to the UP. In this situation the user provides commands and data for buffering but leaves it to the DAS to decide when the DAF service shall be established to upload the information to the UP.
118	4.1.1.1	The Planning Tool shall retain information that characterizes the routine operations of a DAS User. This information becomes a customized user service profile. The profile allows the user to set up requests rapidly while concentrating only on the parameters that change from each instantiation of the service request to the next. The configuration profile significantly reduces the amount of user/Planning Tool interactions for requests that occur frequently in the DAS User's operations repertoire.
144	4.1.1.2	Upon receipt of the planning information, the Planning Tool shall be used to determine how the available time can be used to meet the DA scheduling objectives of the user.
146	4.1.3.3.1	The DAR polling rate shall be user defined.

The DA Planning Tool Function is not decomposed in this document since the DA subsystem is being developed with a parallel line of subsystem specification documentation. Therefore, the document entitled SDD for the DA Planning Tool should be consulted for further decomposition of the DA Planning Tool Function (1.1) and the detailed requirements.

4.1.2 DACDHS Function (1.2)

Purpose - The role of the DACDHS Function is as follows:

- Analyze planning information requests and provide planning information report data based on spacecraft visibility and service resource availability
- Receive and propagate TDRSS spacecraft and USAT state vector updates for use in visibility assessments

- Receive TUT schedules from the NCC and use the information to evaluate planning and DAF service requests
- Manage forward and return commands and data via the formatting, buffering, and routing of the messages between the UPs and the DAS Users
- Allocate forward and return DAS services
- Control the DAS beamforming and demodulator functions
- Orchestrate the system control functions of start up, configuration, testing, and termination

Inputs - The following are the inputs to the DACDHS function (1.2) (refer to Figure 4-3):

- Planning tool information and service requests (PT_Requests)
- Optional DAS User defined satellite visibility constraints (PT_Requests)
- DAS User commands and data for uplinking to the UP (PT_Requests)
- FDF state vectors for TDRSS spacecraft and USATS (FDF_SV)
- DAS equipment command, test, and configuration data from the DAS Operator GUI in internal DAS representation (DAS_Op_CMDs)
- Unformatted return link data from the UP (UP_Data)
- NCC TUT schedules (NCC_TUT)
- TGBFS equipment status and test reports (TGBFS_Status)
- DA RLDRS equipment status, test reports, and return data from the UP (RLDRS_Output)

Processing - The following is a description of DACDHS Function (1.2) processing:

For each DAS User, DAS Operator, NCC, FDF, TGBFS Function (1.3), DA RLDRS Function (1.4), and MAR Service Chain input, the DACDHS Function responds in the following manner:

If DAS User planning information request is received from the DA Planning Tool Function (1.1), the function does the following:

- Accept the planning information request specifications and optional user defined satellite visibility constraints
- Assess the validity of the requests for DAS User planning information
- Analyze TDRSS resource availability, TUT schedules, and satellite visibility information to provide planning information that meets the constraints of the request
- Issue the results of the request analysis as planning reports to the DA Planning Tool Function (1.1)

If DAS User DAF or DAR service request is received from the DA Planning Tool Function (1.1), the function does the following:

- Accept the service request specifications and optional user defined satellite visibility constraints
- Assess the validity of the DA service request by analyzing TDRSS resource availability, TUT schedules, and satellite visibility information to provide planning information that meets the constraints of the request
- Process valid service requests in the following manner:
  - If the request is for a DAF service, the function does the following:

- Orchestrate the implementation of DAS forward service by providing service configuration specifications to the NCC via a SHO-like service request
- Forward buffered and non-buffered DAS User commands and data to the UP
- Set up and control UP command and data buffering, formatting, and routing configurations at each SGLT according to request specifications for forward and return services

- If the request is for a DAR service using DAS equipment, the function does the following:
  - Orchestrate the implementation of DAS return services by providing service configuration specifications to the NCC, the TGBFS Function (1.3) and the DA RLDRS Function (1.4)
  - Control the beamforming and demodulation functions, TGBFS Function (1.3) and the DA RLDRS Function (1.4), respectively, at each SGLT during DAR service operations
  - Buffer, format, and route UP data to the DAS Users
  - Report DAS TDRSS resource utilization to the NCC
- If the request is for a DAR service using existing MAR equipment, the function does the following:
  - Orchestrate the implementation of DAS return services by providing service configuration specifications to the NCC via a SHO-like service request

If TUT schedules and satellite state vectors are received from the NCC and FDF, respectively, the function does the following:

- Propagate updated TDRSS spacecraft and USAT state vectors to obtain spacecraft positions as a function of time and record ephemerides in the DAP Database
- Process TUT schedules to determine DAF service availability and record them in the DAP Database

If DAS Operator system control request is received, the function does the following:

- Assess the validity of the request
- Orchestrates DAS Operator system control, test, and configuration request activities among the DAS functions for each SGLT with a DAS equipment implementation

If TGBFS Function (1.3) or DA RLDRS Function (1.4) status reports are received, the function does the following:

- Construct performance monitoring status reports and send them to the DA Planning Tool Function (1.1)
- Construct and send service progress status reports to the DA Planning Tool Function (1.1)
- Construct system control reports and send them to the DAS Operator

Outputs - The following are the outputs from the DACDHS function (1.2) (refer to Figure 4-3):

- DA service status and planning information reports to the DA Planning Tool Function (1.1) (PT_Info)
- System performance monitoring status reports to the DA Planning Tool Function (1.1) (PT_Info)
- TGBFS equipment configuration for requested service and test specifications (TGBFS_Config)

- DA RLDRS equipment configuration for requested service and test specifications (RLDRS_Config)
- Formatted UP return data (Return_Data)
- Commands and data to the UP (CMDs_to_UP)
- SHOs and DAS TDRSS resource utilization reports to the NCC (DA_SHO)
- DAS equipment status and test reports in GUI representation (DAS_Op_Info)

Function Requirements - Table 4-3 contains a description of the formal processing requirements associated with the DACDHS Function (1.2) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb "shall". Sentences not containing the verb "shall" are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-3 DACDHS Function (1.2) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
19	3.2	Two one-way services are defined for the DAS. These are the one-way DA Forward (DAF) and one-way DA Return (DAR) services. The DAF shall allow commands and data to be sent from the user POCC to the UP. For example, the DAS User can construct combined forward and return services (two-way).
59	3.4.1	Implementation of DAF service shall be based on the existence of a DA forward link control/data handling function that includes the following DA functions: • DAP Function • DAB Function
95	3.4.2.3	DACDHS function shall provide control to the return link DA system and support return link DA data handling.
104	3.4.2.3	The return link DARCM function shall implement all control and status monitoring for the return link DA equipment within a single SGLT.
105	3.4.2.3	DARCM return link function shall include setting/monitoring beamforming mode, sending direction cosines to each IBU, and monitoring beamformer status.
131	4.1.5	SROs shall provide both forward and return DAS User with the capability of changing a previously accepted operations request from the queue of scheduled or ongoing scenarios.
142	3.4.2.3	A Master DAS Operator at one WSC SGLT shall be able to test the DAS equipment at all the SGLTs.

The following sections contain the decomposition of the DACDHS Function (1.2) into the following three subfunctions:

- DAP Function (Section 4.1.2.1)
- DAB Function (Section 4.1.2.2)
- Demand Access Return Control/Monitoring (DARCM) Function (Section 4.1.2.3)

Figure 4-4 shows the results of decomposing the DACDHS Function (1.2).

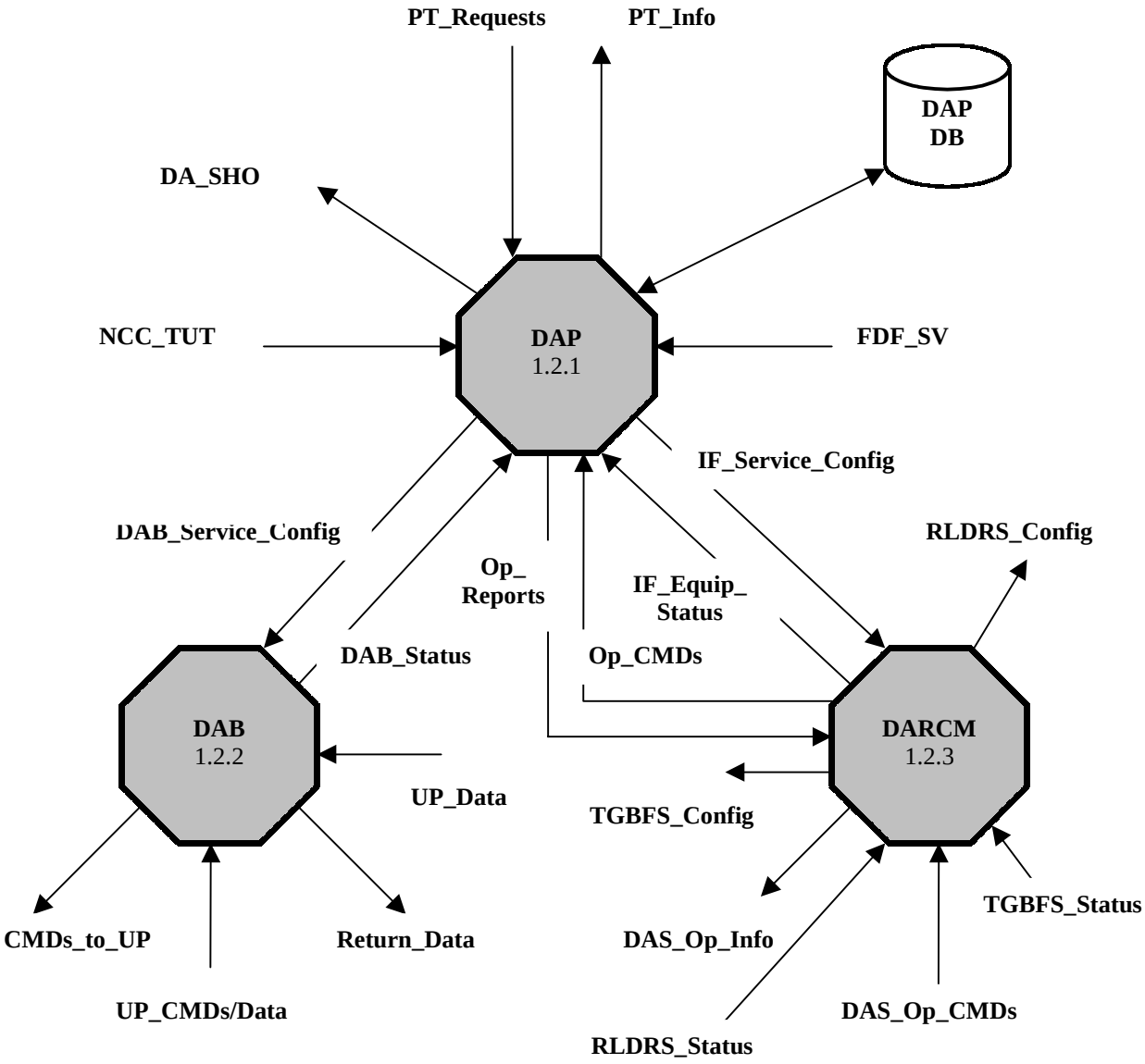

Figure 4-4 DACDHS Function (1.2) Decomposition DFD

4.1.2.1 DAP Function (1.2.1)

Purpose - The role of the DAP Function (1.2.1) is as follows:

- Primary control interface between system users and operator and the DAS equipment
- Manage requests for planning information and services from DAS Users
- Accept NCC TUT schedules and FDF satellite state vectors to support planning and service request visibility and TDRSS resource allocation information
- Analyze visibility and resource data within the constraints imposed by DAS User planning information and service request specifications
- Maintain a database of DAS resource status for service allocation purposes
- Send valid requests for DAF services to the NCC for implementation as MAF services
- Manage the implementation of DAF and DAR services
- Resource status reporting to the NCC and system status reporting to the DAS Users
- Executive controller for system configuration, startup, testing, and termination

Inputs - The following are the inputs to the DAP Function (1.2.1) (refer to Figure 4-4):

- Requests from DAS Users for communications and tracking services, service reconfiguration, and planning information in internal DAS representation (PT_Requests)
- DAS User supplied visibility constraints (PT_Requests)
- NCC TUT schedules and NCC coordinated DA service status (NCC_TUT)
- FDF satellite state vectors (FDF_SV)
- DAB Function (1.2.2) performance monitoring status and test reports (DAB_Status)
- DARCM Function (1.2.3) performance monitoring status and test reports (IF_Equipment_Status)
- DAS Operator system configuration, control, and testing commands (Op_CMDS)
- TDRSS resource, TUT schedules, and USAT ephemerides data (from DAP database)

Processing - The following is a description of DAP Function (1.2.1) processing:

For each DAS User, DAS Operator, NCC, FDF, DAB Function (1.2.2), DARCM Function (1.2.3), and MAR Service Chain input, the DAP Function responds in the following manner:

If a DAS User planning information request is being processed, the function does the following:

- Assess DAS User planning information requests for validity
- Orchestrate analysis processing needed to produce the planning information
- Generate UP visibility profiles from satellite ephemerides, TUT window data, and user supplied visibility constraints to aid in producing planning information
- Generate planning reports based on UP visibility and TDRSS resource considerations

If a DAS User service request is being processed, the function does the following:

- Accept the service request specifications
- Orchestrate analysis processing needed to implement the DA services
- Generate UP visibility profiles from satellite ephemerides, TUT schedule data, and user supplied visibility constraints to aid in implementing DA service requests

- Assess DAS User service request specifications for validity
- Initiate the implementation of DAS forward link services by sending specifications (SHOs) for MAF services to the NCC
- Initiate the implementation of return link services that specify the use of existing MAR equipment by sending the service specifications (SHOs) to the NCC
- Send UP command and data buffering, formatting, and routing specifications to the DAB Function (1.2.2) based on DAS User service requests
- Initiate the implementation of DAS return link services by sending specifications for DAR services to the DARCM Function (1.2.3)
- Collect service status data from the other DAS functions and send the information to the DAS Users

If a DAS Operator system control request is being processed, the function does the following:

- Assess DAS Operator system control and test requests for validity
- Orchestrate DAS Operator system control request such that the minimum impact on overall DAS User services is experienced
- Distribute system control commands for system startup, configuration, status reports, testing, and termination throughout the specified SGLT
- Record DAS equipment status and test results in the DAP database for reporting to DAS Users, DAS Operator, and the NCC

If TUT or satellite state vector updates are provided from the NCC and FDF, respectively, the function does the following:

- Accept and store NCC TUT schedules in the DAP database for access during planning information and service request evaluation assessments
- Accept and propagate FDF supplied TDRSS satellite and USAT state vectors for use in visibility assessment during planning information and service request evaluation assessments
- Store propagated state vector ephemerides in the DAP Database

If a DAB Function (1.2.2) or DARCM Function (1.2.3) status report is received, the function does the following:

- Construct performance monitoring status reports and send them to the DA Planning Tool Function (1.1)
- Construct and send service progress status reports to the DA Planning Tool Function (1.1)
- Construct system control reports for the DAS Operator and send them to the DARCM Function (1.2.3)

Outputs - The following are the outputs from the DAP Function (1.2.1) (refer to Figure 4-4):

- Planning and service status reports sent to the DA Planning Tool Function (1.1) in internal DAS representation (PT_Info)
- DAS Operator system operations reports (Op_Reports)
- SHO-like requests for MAF services (DA_SHO)
- System configuration specifications for the DAB Function (1.2.2) (DAB_Service_Config)

- System configuration specifications for the DARCM Function (1.2.3) (IF_Service_Config)
- DAS TDRSS resource utilization profile reports to the NCC (DA_SHO)
- TDRSS resources, TUT schedules, and USAT ephemerides data (to DAP database)

Function Requirements - Table 4-4 contains a description of the formal processing requirements associated with the DAP Function (1.2.1) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb "shall". Sentences not containing the verb "shall" are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-4 DAP Function (1.2.1) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
12	3.1	The DAS return service requests shall be sent to the DAP from the DA User's POCC.
13	3.1	The DAP shall determine the spatial and temporal constraints associated with a DAS return service request.
14	3.1	The DAP shall send the specifications to the DARCM function to be translated into return service equipment configuration commands.
15	3.1	The DAP shall configure the DAB function to manage the buffering and routing of forward and return service commands and data between the UPs to the associated user POCCs.
17	3.1	The DAP shall perform the navigation computations needed to assign the forward and return services via the propagation of satellite state vectors supplied to the DAP on a regular basis by the FDF.
18	3.1	UP and TDRSS spacecraft position information shall be maintained by the DAP.
21	3.2	The DAF and DAR services shall be the elementary building blocks from which more complicated DA User operations scenarios are made.
26	3.2.1.1	The MAF TUT becomes the DAF scheduling opportunities and shall be the time available for scheduling DAF services for DAF users.
50	3.3.1	The DAP shall place emergency DAF service requests at the beginning of the service request queue.
60	3.4.1.1	The forward link DAP function shall provide the primary control interface between the WSC DA services, the DA Users, and NCC.
61	3.4.1.1	The DAP shall implement both forward and return link DA service control in a manner that minimizes the complexity of DAS User interfaces.
63	3.4.1.1	DAP shall receive and acknowledge DA User requests for forward link DA service and user configuration messages necessary to control DA service.
68	3.4.1.1	DAP shall report status to the user and the NCC.
96	3.4.2.3	The DAP shall provide the primary control interface between the WSC DA services and the DA customers and NCC. The DAP implements both forward and return link DA service control in order to provide a minimum number of interfaces to the user. (Initially, the DAP will support the return link, with forward link control added later.)

Table 4-4 DAP Function (1.2.1) Requirements (Continued)

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
130	4.1.4	Two-way Doppler and range tracking services shall be available as DAS options. DAS requests for either of these services can result in the DAP requesting the NCC to set up the current MA tracking service option. Two-way range will not be supported directly by the DAS equipment. However, a second option exists for two-way Doppler. The two-way Doppler service can be established when the DAS User requests concurrent DA forward and return services while a dedicated demodulator with a Doppler extractor is assigned to the equipment chain.

The following subsections contain the decomposition of the DAP Function (1.2.1) into the following four subfunctions:

- Service Request Handler Function (Section 4.1.2.1.1)
- DAF Service Manager Function (Section 4.1.2.1.2)
- DAR Service Manager Function (Section 4.1.2.1.3)
- Service Resource Analyzer Function (Section 4.1.2.1.4)

Figure 4-5 shows the results of decomposing the DAP Function (1.2.1).

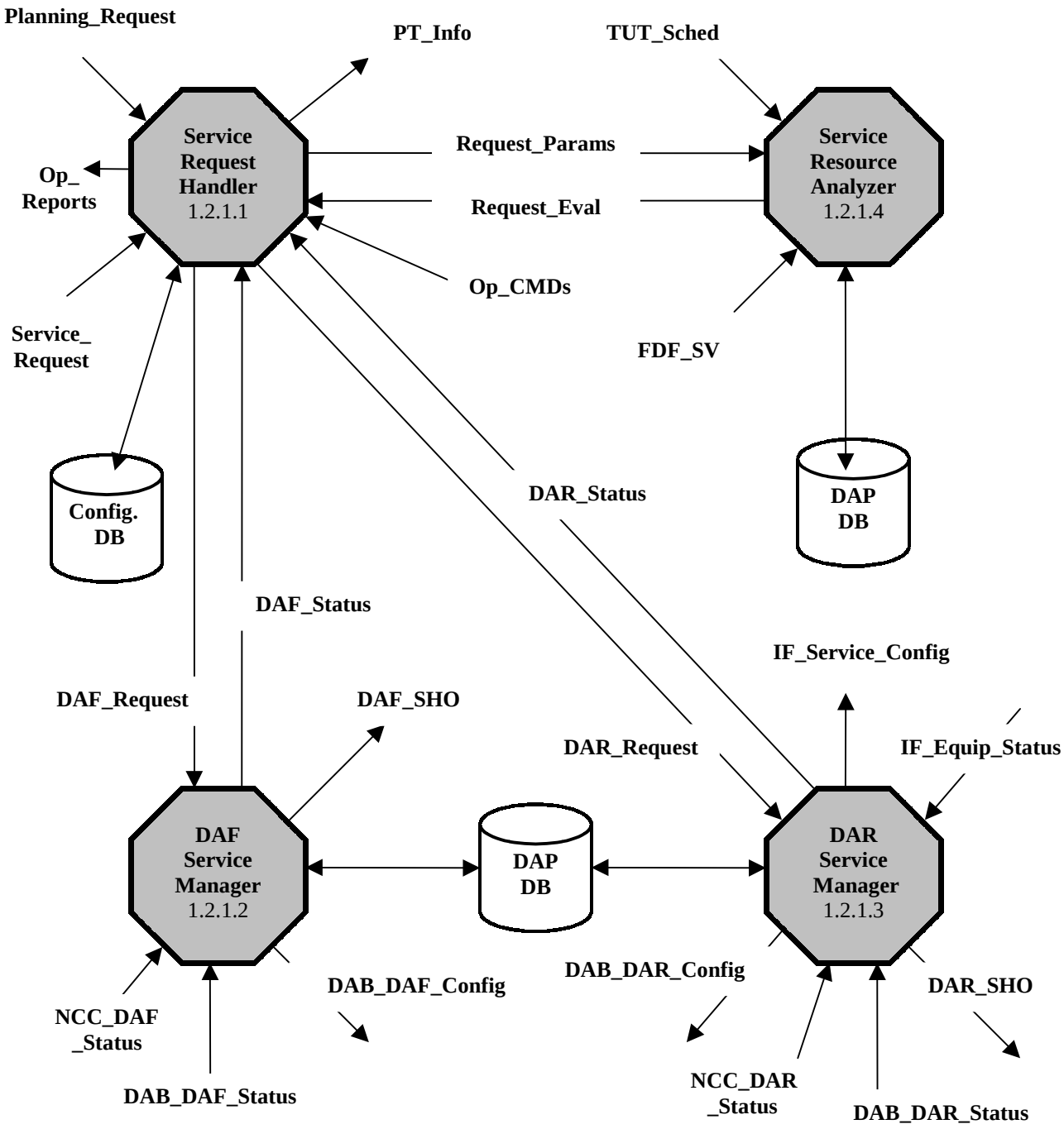

Figure 4-5 DAP Function (1.2.1) Decomposition DFD

4.1.2.1.1 Service Request Handler Function (1.2.1.1)

Purpose - The role of the Service Request Handler Function (1.2.1.1) is as follows:

- Provide the highest level of internal DAS orchestration for the actions required to implement user planning information and service requests
- Provide the highest level of internal DAS orchestration for configuring, cold starting, warm starting, testing, and terminating the DAS

Inputs - The following are the inputs to the Service Request Handler Function (1.2.1.1) (refer to Figure 4-5):

- DAS User requests for planning information and DAS services (Planning_Request)
- DAS User requests for DAF and DAR services (Service_Request)
- DAS Operator request specifications for system control actions (Op_CMDs)
- DAS Operator request specifications for system test (Op_CMDs)
- DAF service based DAS resource status reports (DAF_Status)
- DAR service based DAS resource status reports (DAR_Status)
- Assessments of DAS resource availability for planning information from the Service Resource Analyzer Function (1.2.1.4) (Request_Eval)
- DAS initialization configuration data (from DAS Configuration Database)
- DAF Service Manager Function (1.2.1.2) performance monitoring status and test reports (DAF_Status)
- DAF Service Manager Function (1.2.1.3) performance monitoring status and test reports (DAR_Status)
- Service Resource Analyzer Function (1.2.1.4) performance monitoring status and test reports (Request_Eval)

Processing - The following is a description of Service Request Handler Function (1.2.1.1) processing:

For each service request and system control request input, the Service Request Handler Function responds in the following manner:

If a DA Planning Tool request is received, the function does the following:

- Transform DAS User planning information and service requests into an internal DAS format and send the request to the Service Resource Analyzer Function (1.2.1.4)
- Accept the Service Resource Analyzer Function (1.2.1.4) analysis results for planning information and service request evaluations
- Verify that DAF and DAR service requests and Service Reconfiguration Orders (SROs) are valid based on the Service Resource Analyzer Function (1.2.1.4) and then direct the appropriate service manager to implement valid requests
- Report invalid service planning information of service implementation request specifications to the DAS User
- Transform Service Resource Analyzer Function (1.2.1.4) output into a report form to be sent to the DA Planning Tool Function (1.1)
- Send valid DAF and DAR service configuration parameters to the DAF Service Manager Function (1.2.1.2) and the DAR Service Manager Function (1.2.1.3), respectively

If a DAS Operator system control request is received, the function does the following:

- Accept DAS Operator system control request and assess the validity of the request
- Orchestrate the activities associated with DAS Operator request for configuring, cold starting, warm starting, testing, and terminating the DAS by sending system control commands to the DAF Service Manager Function (1.2.1.2) , the DAR Service Manager Function (1.2.1.3), and the Service Resource Analyzer Function (1.2.1.4)
- Maintain system configuration data (in the Configuration Database) and apply it to initialize the DAS at start-up
- Function (1.2.1.3), and the Service Resource Analyzer Function (1.2.1.4)

If a DAF Service Manager Function (1.2.1.2), DAR Service Manager Function (1.2.3), or a Service Resource Analyzer status report is received, the function does the following:

- Construct performance monitoring status reports and send them to the DA Planning Tool Function (1.1)
- Construct and send service progress status reports to the DA Planning Tool Function (1.1)
- Construct system control reports for the DAS Operator and send them to the DARCM Function (1.2.3)

Outputs - The following are the outputs from the Service Request Handler Function (1.2.1.1) (refer to Figure 4-5):

- Resource assessment requests to the Service Resource Analyzer Function (1.2.1.4) (Request_Params)
- DAF and DAR service and performance monitoring status reports to the DAS User (PT_Info)
- DAS control status and test reports to the DAS Operator (Op_Reports)
- Forward link service configuration parameters to the DAF Service Manager Function (1.2.1.2) (DAF_Request)
- Return link service configuration parameters to the DAR Service Manager Function (1.2.1.3) (DAR_Requests)
- DAS initialization configuration data (to the DAS Configuration Database)

Function Requirements - Table 4-5 contains a description of the formal processing requirements associated with the Service Request Handler Function (1.2.1.1) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb “shall”. Sentences not containing the verb “shall” are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-5 Service Request Handler Function (1.2.1.1) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
22	3.2	The DA User shall be allowed to schedule the one-way DAF and DAR services in the following ways (depending on the user's mission operations objectives): • separately, • with overlapping time windows, or • simultaneously
30	3.2.1.1	After a suitable range of MAF times are identified with the Planning Tool, the DAS User shall request the DAP to establish the DAF service.
31	3.2.1.1	DAF services shall be allocated on a first come, first served basis for DAS Users.
100	3.4.2.3	DAP Return link function provided shall include return DA status reporting to the DA customer and NCC.
132	4.1.5	SROs shall include the cancellation of a previously accepted request
133	4.1.5	SROs shall include the lengthening or shortening of the duration of a request
134	4.1.5	SROs shall include the termination of an operations scenario currently being executed
135	4.1.5	SROs shall include the request for alternative equipment chains
136	4.1.5	SROs shall include a change to the beamformer mode

4.1.2.1.2 DAF Service Manager Function (1.2.1.2)

Purpose - The role of the DAF Service Manager Function (1.2.1.2) is as follows:

- Coordinate the implementation of DAF requests with the DAB Functions (1.2.2) and the NCC
- Notify the NCC to allocate the DAF service using existing MAF TDRSS resources
- Provide the DAB Function with DAF command and data buffering specifications for the DAF service
- Manage normal DAF service requests on a first come, first served basis (except for emergency requests which are given the highest priority)

Inputs - The following are the inputs to the DAF Service Manager Function (1.2.1.2) (refer to Figure 4-5):

- DAF service requests from the Service Request Handler Function (1.2.1.1) (DAF_Request)
- DAF service configuration and test specifications from the Service Request Handler Function (1.2.1.1) (DAF_Request)
- DAF service resource status (from the DAP Database)
- DAF DAB buffering, formatting, and routing status reports, performance monitoring status reports, and system test reports from the DAB Function (1.2.2) (DAB_DAF_Status)
- NCC coordinated DAF status reports (NCC_DAF_Status)

Processing - The following is a description of DAF Service Manager Function (1.2.1.2) processing:

For each DAF service request, system control request, and DAB Function status input, the DAF Service Manager Function responds in the following manner:

If a DAF service request is received, the function does the following:

- Accept requests for DAF services from the Service Request Handler Function (1.2.1.1)
- Manage the service requirements for a first in, first out queue of DAF users (with an emergency service request contingency priority exception)
- Construct a SHO-like message for DAF service implementation using request specifications
- Send the SHO-like message to the NCC to obtain a MAF service
- Send MAF service status reports from the NCC to the Service Request Handler Function (1.2.1.1)
- Send DAR service and system control status reports to the Service Handler Function (1.2.1.1)
- Record DAF service allocation specifications in the DAP Database
- Construct DAF service buffering, formatting, and routing specifications and send them to the DAB Function (1.2.2)

If a system control request is received, the function does the following depending on the request specifications:

- Install system configuration parameters
- Perform startup or termination operations
- Exercise testing of the function as part of DAS control

If a DAB Service Function (1.2.1.2) DAF status report is received, the function does the following:

- Accept DAF buffering, formatting, and routing status reports from the DAB Function (1.2.2) and record the current state of operations in the DAP Database
- Construct performance monitoring status reports and send them to the Service Request Handler Function (1.2.1.1)
- Construct and send service progress status reports to the Service Request Handler Function (1.2.1.1)
- Construct system control reports for the DAS Operator and send them to the Service Request Handler Function (1.2.1.1)
- Extract system control status and test information from the DAP Database for reporting to the Service Request Handler Function (1.2.1.1)

Outputs - The following are the outputs from the DAF Service Manager Function (1.2.1.2) (refer to Figure 4-5):

- DAF service resource status to the DA Database and the Service Request Handler Function (1.2.1.1) (DAF_Status)
- SHO-like DAF service requests to the NCC (DAF_SHO)

- DAF command and data buffering specifications to the DAB Function (1.2.2) (DAB_DAF_Config)

Function Requirements - Table 4-6 contains a description of the formal processing requirements associated with the DAF Service Manager Function (1.2.1.2) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb "shall". Sentences not containing the verb "shall" are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-6 DAF Service Manager Function (1.2.1.2) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
23	3.2.1.1	The DAF service shall be essentially a MAF forward service that has been appropriated through the DAS allocation process.
33	3.2.1.1	DAS User requests for the DAF services shall be automatically coordinated through the NCC.
34	3.2.1.1	Requests, similar to Scheduling Orders (SHOs), shall be sent from the DAP to the NCC in order to configure the GT equipment chain to support the DAP requested DAF service.
48	3.3.1	There shall be only two DAF user priorities, normal and emergency.
49	3.3.1	Under normal operating conditions, DAF services shall be allocated on a first come, first served basis.
52	3.3.1	DAF handover shall be scheduled by the DAS User as a series of consecutive DAF requests spanning two or more different TDRS visibility time windows.

4.1.2.1.3 DAR Service Manager Function (1.2.1.3)

Purpose - The role of the DAR Service Manager Function (1.2.1.3) is as follows:

- Orchestrate the implementation of DAR services using DAS equipment chains at the SGLTs
- Provide the DAB Function with DAR data buffering, formatting, and routing specifications for the DAR service
- Notify the NCC to allocate the DAR service using existing MAR TDRSS resources in the event that existing MAR equipment chains are requested

Inputs - The following are the inputs to the DAR Service Manager Function (1.2.1.3) (refer to Figure 4-5):

- DAR service requests from the Service Request Handler Function (1.2.1.1) (DAR_Request)
- DAR service initialization configuration and test specifications (DAR_Request)
- DAR DAB status from the DAB Function (1.2.2) (DAB_DAR_Status)
- DAS return link equipment chain status and system control test reports (IF_Equip_Status)
- DAR service resource status (from the DAP Database)

- DAR DAB buffering, formatting, and routing status reports, performance monitoring status reports, and system test reports from the DAB Function (1.2.2) (DAB_DAR_Status)
- NCC coordinated DAR status reports (NCC_DAR_Status)

Processing - The following is a description of DAR Service Manager Function (1.2.1.3) processing:

For each DAR service request, system control request, DARCM Function, and DAB Function status input, the DAR Service Manager Function responds in the following manner:

If a DAR service request for DAS equipment is received, the function does the following:

- Accept requests for DAR services from the Service Request Handler Function (1.2.1.1)
- Manage the service requirements for DAR users
- Record DAR service allocation specifications in the DAP Database
- Accept DAB Function (1.2.2) DAR buffering status reports and record the current state of operations in the DAP Database
- Construct DAR service buffering, routing, and formatting requests and send them to the DAB Service Manager Function (1.2.2.1)
- Transform the DAR service request into a representation that can be used by the DAR equipment chain controllers to implement the desired service specifications and forward it to them
- Send DAR service specifications to the DARCM Function (1.2.3) to be used in controlling the TGBFS Function (1.3) and DA RLDRS Function (1.4) while the service is implemented
- Extract DAR status and allocation information from the DAP Database for reporting to the Service Request Handler Function (1.2.1.1)
- Extract DARCM Function status from the DAP Database for reporting to the Service Request Handler Function (1.2.1.1)
- Send DAR service and system control status reports to the Service Handler Function (1.2.1.1)
- Extract direction cosines from the DAR Database

If a DAR service request for MAR existing equipment is received, the function does the following:

- Send SHO-like requests to the NCC to establish MAR service
- Send NCC coordinated DAR service status reports the Service Handler Function (1.2.1.1)

If a system control request is received, the function does the following depending on the request specifications:

- Install system configuration parameters
- Perform startup or termination operations
- Exercise testing of the function as part of DAS control operations

If a DAB Service Function (1.2.1.2) DAR status report or a DARCM Function (1.2.3) is received, the function does the following:

- Accept DAR buffering, formatting, and routing status reports, performance monitoring status reports, and system control test reports from the DAB Function (1.2.2) and record the current state of operations in the DAP Database
- Accept DAR equipment controller status reports from the DARCM Function (1.2.3) and record the current state of operations in the DAP Database
- Extract system control status and test information from the DAP Database for reporting to the Service Request Handler Function (1.2.1.1)
- Construct performance monitoring status reports and send them to the Service Request Handler Function (1.2.1.1)
- Construct and send service progress status reports to the Service Request Handler Function (1.2.1.1)
- Construct system control reports for the DAS Operator and send them to the Service Request Handler Function (1.2.1.1)

Outputs - The following are the outputs from the DAR Service Manager Function (1.2.1.3) (refer to Figure 4-5):

- DAR service resource status to the Service Request Handler Function (1.2.1.1) (DAR_Status)
- DAR data buffering specifications to the DAB Function (1.2.2) (DAB_DAR_Config)
- DAR service configuration data for the DAR equipment chain controllers (IF_Service_Config)
- DAR SHO-like requests to the NCC for MAR services via the existing non-DAS equipment (DAR_SHO)
- DAR service resource status (to the DAP Database)
- Direction cosines for each DAR user (IF_Service_Config)

Function Requirements - Table 4-7 contains a description of the formal processing requirements associated with the DAR Service Manager Function (1.2.1.3) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb “shall”. Sentences not containing the verb “shall” are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-7 DAR Service Manager Function (1.2.1.3) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
43	3.2.1.2	The DAP shall choose DAS beamforming and demodulator equipment if the option arises to use new or existing equipment.
44	3.2.1.2	If the existing equipment is chosen in place of DAS resources, the scheduling of the equipment shall occur through NCC and is transparent to the DAS User.
55	3.3.2	If DAS Users do not choose to provide their own beamforming and demodulator equipment, then the DAP shall choose an available set of TDRSS dedicated equipment for the user service
97	3.4.2.3	DAP return link function provided shall include receipt of user DA return service control messages including service parameters and data handling instructions (e.g., real time return vs. data buffering).
98	3.4.2.3	DAP return link function provided shall include high level control messaging to/from the return DA equipment via NCC.
99	3.4.2.3	DAP return link function provided shall include high level control of the Demand Access Buffer in order to configure DA return link data handling

4.1.2.1.4 Service Resource Analyzer Function (1.2.1.4)

Purpose - The role of the Service Resource Analyzer Function (1.2.1.4) is as follows:

- Maintain and update UP visibility information in the DAP Database
- Analyze visibility data and resource allocation data in the DAP Database to support planning information and service request
- Validate DA service requests based on visibility and resource availability criteria

Inputs - The following are the inputs to the Service Resource Analyzer Function (1.2.1.4) (refer to Figure 4-5):

- NCC TUT schedules (TUT_Sched)
- FDF satellite state vector updates (FDF_SV)
- DAS User defined visibility constraints (Request_Params)
- Planning information and service request specifications (Request_Params)
- Test specification parameters (Request_Params)
- DAS equipment chain allocations, USAT ephemerides, and visibility schedules (from the DAP Database)

Processing - The following is a description of Service Resource Analyzer (1.2.1.4) processing:

For each service analysis request, system control, NCC, and FDF status input, the Service Analyzer Function responds in the following manner:

If a service analysis request is received, the function does the following depending on the request specifications:

- Accept service analysis requests and extract specifications for the service assessment
- Superimpose (Boolean "anded") optional DAS User defined visibility constraints on the omni-directional visibility profiles automatically produced by this function
- Extract DA resource information from the DAP database for planning and service request assessments
- Assess visibility and resource availability in order to determine the service allocation constraints associated with the request
- Evaluate DAS User service requests and validate based on consistency with DAS resource availability and visibility constraints
- Construct planning information reports based on the results of the analysis of the DAS resource availability and visibility constraints
- Generate direction cosines for the TDRS to user platform position vector to support real-time TGBFS beamforming requirements
- Store direction cosines in DAP Database

If a NCC or FDF input is received, the function does the following depending on the type of data:

- Accept NCC TUT schedules and transform them into a format for use in visibility analysis and recorded in the DAP Database
- Accept FDF satellite state vectors and propagate them forward in time to support visibility analysis and recorded in the DAP Database
- Accept FDF satellite ephemeris and provide for propagation beyond the end time point to support visibility analysis and record in the DAP Database
- Accept FDF satellite ephemeris and provide for interpolation of vectors at time points between vectors to support visibility analysis and record in the DAP Database

If a system control request is received, the function does the following depending on the request specifications:

- Install system configuration parameters
- Perform startup or termination operations
- Obtain function status and record in DAP Database
- Exercise the function test as part of DAS control operations and record results in DAP database

Outputs - The following are the outputs from the Service Resource Analyzer Function (1.2.1.4) (refer to Figure 4-5):

- Planning information and service request analysis reports (Request_Eval)
- Satellite ephemerides (to the DAP Database)
- Reformatted TUT scheduling data (to the DAP Database)
- Direction cosines for DAR service (DAP Database)

Function Requirements - Table 4-8 contains a description of the formal processing requirements associated with the Service Resource Analyzer Function (1.2.1.4) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb "shall". Sentences not containing the verb "shall" are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-8 Service Resource Analyzer Function (1.2.1.4) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
25	3.2.1.1	Each day, the NCC shall assess the amount of TUT that is available for the next ten days and broadcasts the TUT schedule via the Internet to TDRSS users.
27	3.2.1.1	TUT time shall be allotted to DAS Users in intervals that are no larger than the interval of time separating two consecutive MAF time slots on the active schedule.
28	3.2.1.1	In order to establish a DAF service, the user POCC shall request the time based on the MAF TUT options monitored by the DAP.
45	3.3.1	The DAS shall decide which TDRS will be used for most service requests.
47	3.3.1	Each individual DAF service duration shall be limited by the length of the MAF TUT intervals in the NCC active schedule.
62	3.4.1.1	DAP shall receive TUT daily messages from NCC. This information permits the sharing of scheduled and DA service on a single SGLT by allowing the DAP to avoid requesting DA service during previously scheduled service intervals.
64	3.4.1.1	DAP shall calculate user spacecraft visibility intervals and determine user spacecraft to TDRSS spacecraft line of sight for omni-directional antenna services.
65	3.4.1.1	DAP shall select an appropriate TDRSS spacecraft for service.
66	3.4.1.1	The DAP shall accept UP visibility schedules provided by DAS Users.
120	4.1.1.2	The DAP processor shall automatically update the DAS database as updated spacecraft state vectors and TUT schedules are supplied from the FDF and NCC, respectively.

4.1.2.2 DAB Function (1.2.2)

Purpose - The role of the DAB Function (1.2.2) is as follows:

- Provide capabilities for buffering, formatting, and routing of DA forward return link data

Inputs - The following are the inputs to the DAB Function (refer to Figure 4-4):

- DA forward link commands and data for the UP (UP_Data)
- DA return link data from the UP (UP_CMDs /Data)
- DA forward and return service specifications (DAB_Service_Config)
- Test specification parameters (DAB_Service_Config)

Processing - The following is a description of DAB Function (1.2.2) processing:

For each service configuration request, forward link data input, return link data input, system control request received, the DAB Function responds in the following manner:

If a service configuration request is received, the function does the following:

- Implement specifications for forward and return link data buffering, formatting, and routing that are provided by the DAP Function (1.2.1)
- Construct buffering, formatting, and routing status reports and send them to the DAP Function (1.2.1)

If forward link commands and data are input, the function does the following:

- Buffer DA forward link commands and data in the DAB database for a user specified interval or transmitted immediately to the UP depending on the service configuration specifications

If return link data is input, the function does the following:

- Buffer DA return link data from the UP or send it to the DAS User in real-time depending on the service configuration specifications

If a system control request is received, the function does the following:

- Assess system control and test requests for validity
- Orchestrate system control request such that the minimum impact on overall DAS User services is experienced
- Record DAS equipment status and test results in the DAB Database for reporting to DAS Users, DAS Operator, and the NCC
- System control status, performance monitoring status reports, and test reports are constructed and sent to the DAP Function (1.2.1)

Outputs - The following are the outputs from the DAB Function (1.2.2) (refer to Figure 4-4):

- DAB Function status (DAB_Status)
- Test reports from DAB functions (DAB_Status)
- DA forward link commands and data (CMDs_to_UP)
- DA return link data (Return_Data)

Function Requirements - Table 4-9 contains a description of the formal processing requirements associated with the DAB Function (1.2.2) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb “shall”. Sentences not containing the verb “shall” are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-9 DAB Function (1.2.2) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
20	3.2	The DAR service shall allow the user POCC to receive data sent from the UP.
36	3.2.1.1	Once the DAF service is established, user commands and data shall be sent directly to the DAB for formatting and buffering for immediate uplinking to the UP.
37	3.2.1.1	The DAS User shall have the choice to have the command data buffered at the DAB for a delayed uplinking at a specified time after the DAF service begins.
70	3.4.1.2	The DAB for the DAF link shall support forward link DA data buffering. On the forward link, user data may either be passed through the DAB in real time at the time of service initiation or stored within the DAB prior to service initiation.
102	3.4.2.3	DA return link functions supported by the DAB shall include formatting/routing of DA return link data to DA customers. Return link data includes both user spacecraft generated data and (optionally) tracking data messages from the DA demodulators.

The following sections contain the decomposition of the DAB Function (1.2.2) into the following four subfunctions:

- DAB Service Manager Function (Section 4.1.2.2.1)
- Data Buffering Function (Section 4.1.2.2.2)
- Data Formatting Function (Section 4.1.2.2.3)
- Data Routing Function (Section 4.1.2.2.4)

Figure 4-6 shows the results of decomposing the DAB Function (1.2.2).

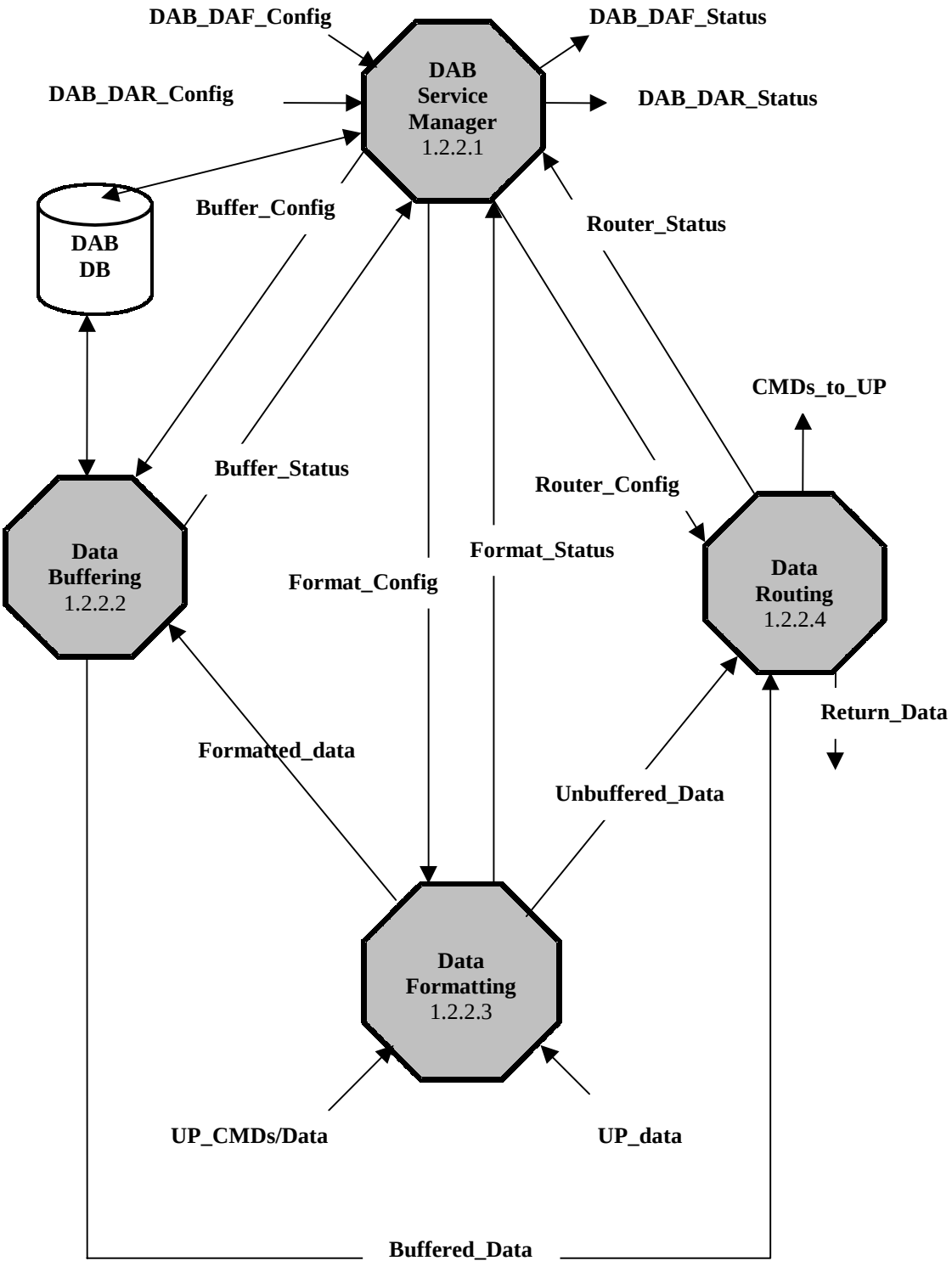

Figure 4-6 DAB Function (1.2.2) Decomposition DFD

4.1.2.2.1 DAB Service Manager Function (1.2.2.1)

Purpose - The role of the DAB Service Manager Function (1.2.2.1) is as follows:

- Orchestrate the activation of DAB subfunctions based on the specifications of each DAS User service request
- Orchestrate system control activities of system configuration, start up, termination, and testing within the DAB Function (1.2.2)

Inputs - The following are the inputs to the DAB Service Manager Function (1.2.2.1) (refer to Figure 4-6):

- Specifications for DA forward and return service command and data management (DAB_DAF_Config)
- Test specification parameters (DAB_DAF_Config)
- Buffer status and system control reports (Buffer_Status)
- Data formatting status and system control reports (Format_Status)
- Data routing status and system control reports (Router_Status)
- System control report data (from the DAB Database)

Processing - The following is a description of DAB Service Manager Function (1.2.2.1) processing:

For each service configuration request and system control request received, the DAB Service Manager Function responds in the following manner:

If a service configuration request is received, the function does the following:

- Transform service buffering, formatting, and routing specifications into service configuration directives and send them to the Data Buffering Function (1.2.2.2), the Data Formatting Function (1.2.2.3), and the Data Routing Function (1.2.2.4), respectively
- Collect status reports from the data buffering, routing, and formatting DAB subfunctions and consolidate them for reporting to the DAF and DAR Service Manager Functions, (1.2.1.2) and (1.2.1.3), respectively

If a system control request is received, the function does the following:

- Asses the system control and test requests for validity
- Orchestrate system control request such that the minimum impact on overall DAS User services is experienced
- Record DAS equipment status and test results in the DAP database for reporting to DAS Users, DAS Operator, and the NCC
- Archive system control data in DAB Database
- Construct system control status and test reports from data stored in the DAB Database and send them to the DAP Function (1.2.1)

Outputs - The following are the outputs from the DAB Service Manager Function (1.2.2.1) (refer to Figure 4-6):

- DAB forward configuration status reports (DAB_DAF_Status)
- DAB return configuration status reports (DAB_DAR_Status)
- Buffering and test specifications for DA forward and return services (Buffer_Config)
- Formatting and test specifications for DA forward and return services (Format_Config)
- Routing and test specifications for DA forward and return services (Router_Config)
- System control report data (to the DAB Database)

Function Requirements - Table 4-10 contains a description of the formal processing requirements associated with the DAB Service Manager Function (1.2.2.1) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb "shall". Sentences not containing the verb "shall" are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-10 DAB Service Manager Function (1.2.2.1) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
101	3.4.2.3	The DAB function shall support data handling for both forward and return link DA services.

4.1.2.2.2 Data Buffering Function (1.2.2.2)

Purpose - The role of the Data Buffering Function (1.2.2.2) is as follows:

- Implement the buffers for the DA forward and return link commands and data

Inputs - The following are the inputs to the Data Buffering Function (1.2.2.2) (refer to Figure 4-6):

- Specifications for buffering for each service request (Buffer_Config)
- System control specification parameters from the DAB Function (1.2.2) (Buffer_Config)
- Formatted forward and return link data (Formatted_Data)
- Buffered commands and data (from the DAB Database)

Processing - The following is a description of Data Buffering Function (1.2.2.2) processing:

For each service configuration request and system control request received, the Data Buffering Function responds in the following manner:

If a service configuration request is received, the function does the following:

- Set up and manage the data buffers according to DAF or DAR service request specifications obtained from the DAB Service Manager Function (1.2.2.1)
- Accept data from the Data Formatting Function (1.2.2.3)
- Store data in the DAB database buffers for specified time period

- Retrieve buffered data in the DAB database when transmission time of the service specification has been achieved
- Forward retrieved data to the Data Routing Function (1.2.2.4)
- Construct Data Buffer Function status reports and send them to the DAB Service Manager Function (1.2.2.1)

If a system control request is received, the function does the following:

- Orchestrate system control request such that the minimum impact on overall DAS User services is experienced
- Send DAS equipment status and system control results to the DAB Service Manager Function (1.2.2.1)

Outputs - The following are the outputs from the Data Buffering Function (1.2.2.2) (refer to Figure 4-6):

- Buffer status and test reports (Buffer_Status)
- Buffered forward and return link data (Buffered_Data)
- Formatted commands and data (to the DAB Database)

Function Requirements - Table 4-11 contains a description of the formal processing requirements associated with the Data Buffering Function (1.2.2.2) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb "shall". Sentences not containing the verb "shall" are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-11 Data Buffering Function (1.2.2.2) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
71	3.4.1.2	The DAB for the DAR link shall support return data link buffering. If the user is lost or the user decides to go off-line during DAR operations, data will be buffered by the DAB function.
103	3.4.2.3	DA return link functions supported by the DAB shall include return link DA data buffering. On the return link, customer data may be routed to the customer (via the closed IOnet) in real time or, for users having limited amounts of data, data may be stored for later retrieval by the customer.

4.1.2.2.3 Data Formatting Function (1.2.2.3)

Purpose - The role of the Data Formatting Function (1.2.2.3) is as follows:

- Provide formatting operations for forward and return link commands and data

Inputs - The following are the inputs to the Data Formatting Function (1.2.2.3) (refer to Figure 4-6):

- Specifications for formatting for each service request (Format_Config)

- System control specification parameters from the DAB Function (1.2.2) (Format_Config)
- Unformatted forward link commands and data to the UPs (UP_CMDs/Data)
- Unformatted return link data to the DAS Users (UP_data)

Processing - The following is a description of Data Formatting Function (1.2.2.3) processing:

For each service configuration request and system control request received, the Data Formatting Function responds in the following manner:

If a service configuration request is received, the function does the following:

- Set up and manage the data formatting according to DAF or DAR service request specifications obtained from the DAB Service Manager Function (1.2.2.1)
- Accept forward and return link unformatted data and commands and format the data according to the specifications for the service
- If the data transmission is to be delayed, send the formatted data to the Data Buffering Function (1.2.2.2)
- If the data is to be transferred in real-time without a delay, send the formatted data to the Data Routing Function (1.2.2.4)
- Construct Data Formatting Function status reports and send them to the DAB Service Manager Function (1.2.2.1)

If a system control request is received, the function does the following:

- Orchestrate system control request such that the minimum impact on overall DAS User services is experienced
- Send DAS equipment status and system control results to the DAB Service Manager Function (1.2.2.1)

Outputs - The following are the outputs from the Data Formatting Function (1.2.2.3) (refer to Figure 4-6):

- Formatted forward link commands and data for buffering (Formatted_data)
- Formatted return link data for buffering (Formatted_data)
- Formatting status and system control reports (Format_Status)
- Real-time formatted forward link data and commands (Unbuffered_Data)
- Real-time formatted return link data (Unbuffered_Data)

Function Requirements - Table 4-12 contains a description of the formal processing requirements associated with the Data Formatting Function (1.2.2.3) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb “shall”. Sentences not containing the verb “shall” are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-12 Data Formatting Function (1.2.2.3) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
69	3.4.1.2	The DAB for the DAF link shall support acceptance of forward link DA data from DA Users.
72	3.4.1.2	The DAB for the DAR link shall support formatting of return link data.

4.1.2.2.4 Data Routing Function (1.2.2.4)

Purpose - The role of the Data Routing Function (1.2.2.4) is as follows:

- Route forward and return link formatted data to the appropriate destination within the DAS

Inputs - The following are the inputs to the Data Routing Function (1.2.2.4) (refer to Figure 4-6):

- Formatted real-time forward link commands and data (Unbuffered_Data)
- Formatted real-time return link data (Unbuffered_Data)
- Buffered forward link commands and data (Buffered_Data)
- Buffered return link data (Buffered_Data)
- Routing specifications for each service request (Router_Config)
- System control specification parameters from the DAB Function (1.2.2) (Router_Config)

Processing - The following is a description of Data Routing Function (1.2.2.4) processing:

For each service configuration request and system control request received, the Data Formatting Function responds in the following manner:

If a service configuration request is received, the function does the following:

- Set up and manage the data routing according to DAF or DAR service request specifications obtained from the DAB Service Manager Function (1.2.2.1)
- Service specifications are assessed to update routing tables for message packet data transfer
- Apply Destination addresses and network information to the message packets containing formatted data and commands
- Send data message packets to the destination identified in the service specification
- Construct Data Routing Function status reports and send them to the DAB Service Manager Function (1.2.2.1)

If a system control request is received, the function does the following:

- Orchestrate system control request such that the minimum impact on overall DAS User services is experienced
- Send DAS equipment status and system control results to the DAB Service Manager Function (1.2.2.1)

Outputs - The following are the outputs from the Data Routing Function 1.2.2.4) (refer to Figure 4-6):

- Routing status reports (Router_Status)
- Function test reports (Router_Status)
- Forward link data and commands (CMDs_to_UP)
- Return link data (Return_Data)

Function Requirements - Table 4-13 contains a description of the formal processing requirements associated with the Data Routing Function (1.2.2.4) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb "shall". Sentences not containing the verb "shall" are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-13 Data Routing Function (1.2.2.4) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
73	3.4.1.2	The DAB for the DAR link shall support routing of return link data.

4.1.2.3 DARCM Function (1.2.3)

Purpose - The role of the DARCM Function (1.2.3) is as follows:

- Controls the DAS return link equipment
- Supports the DAS Operator GUI functions

Inputs - The following are the inputs to the DARCM Function (1.2.3) (refer to Figure 4-4):

- Service configuration specifications (IF_Service_Config)
- System control specification parameters (IF_Service_Config)
- TGBFS equipment status (TGBFS_Status)
- RLDRS equipment status (RLDRS_Status)
- DAS Operator form command data (DAS_Op_CMDs)
- DAS Operator system reports in internal DAS representation (Op_Reports)

Processing - The following is a description of DARCM Function (1.2.3) processing:

For each service configuration request, system control request, and DAS Operator GUI based transaction encountered, the DARCM Function responds in the following manner:

If a service configuration request is received, the function does the following:

- Set up and manage the DAR equipment control according to service request specifications obtained from the DAP Function (1.2.1)
  - Control the TGBFS Function (1.3) based on DAR service specifications
  - Control the DA RLDRS Function (1.4) based on DAR service specifications

- Collect service status information from the DAS return link equipment controllers and formats it into reports which are sent to the DAP Function (1.2.1)

If a DAS Operator GUI based transaction is encountered, the function does the following:

- Transform DAS Operator GUI inputs into DAS internal representation and send it to the DAP Function (1.2.1)
- Transform system status reports from the DAP Function (1.2.1) into GUI formats for presentation to the DAS Operator

If a system control request is received, the function does the following:

- Assess system control and test requests for validity
- Orchestrate system control request such that the minimium impact on overall DAS User services is experienced
- System control status and test reports are constructed and sent to the DAP Function (1.2.1)

Outputs - The following are the outputs from the DARCM Function (1.2.3) (refer to Figure 4-4):

- Service status reports (IF_Equip_Status)
- Test reports (IF_Equip_Status)
- Service configuration parameters for TGBFS equipment (TGBFS_Config)
- Service configuration parameters for RLDRS equipment (RLDRS_Config)
- Operator command data in internal DAS representation (Op_CMDs)
- DAS equipment status reports (DAS_Op_Info)

Function Requirements - Table 4-14 contains a description of the formal processing requirements associated with the DARCM Function (1.2.3) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb "shall". Sentences not containing the verb "shall" are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-14 DARCM Function (1.2.3) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
10	3.1	The DARCM function shall control the return service DAS SGLT equipment configuration.
11	3.1	The DARCM function shall configure the beamforming and demodulation functions according to the demands of the DAS return service requests.

The following sections contain the decomposition of the DARCM Function (1.2.3) to the following three subfunctions:

- DAS Operator MMI Function (Section 4.1.2.3.1)
- TGBFS Controller Function (Section 4.1.2.3.2)
- DA RLDRS Controller Function (Section 4.1.2.3.3)

Figure 4-7 shows the results of decomposing the DARCM Function (1.2.3).

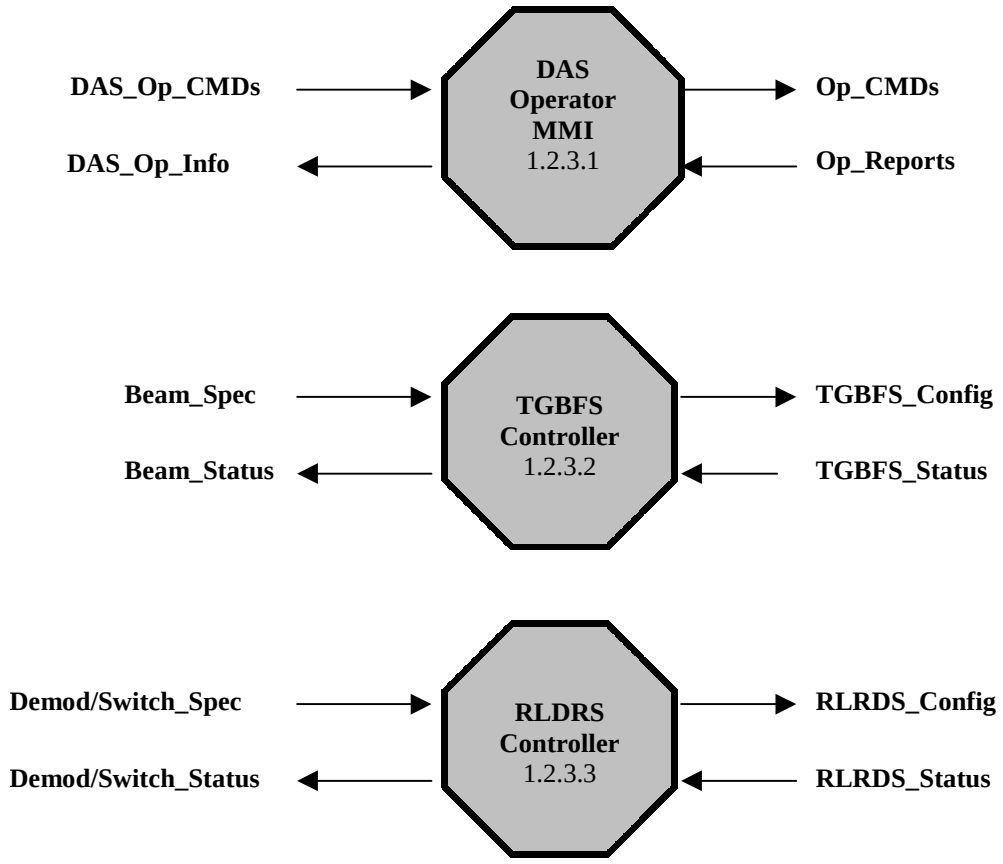

Figure 4-7 DARCM Function (1.2.3) Decomposition DFD

4.1.2.3.1 DAS Operator Man Machine Interface (MMI) Function (1.2.3.1)

Purpose - The role of the DAS Operator MMI Function (1.2.3.1) is as follows:

- Provides an interface for the DAS Operator to enter system control commands into the system and receive system control reports from the DAS equipment

Inputs - The following are the inputs to the DAS Operator MMI Function (1.2.3.1) (refer to Figure 4-7):

- DAS Operator system control and test commands entered into GUI forms (DAS_Op_CMDs)
- System test parameters in GUI representation (DAS_Op_CMDs)
- Operations reports in internal DAS representation from the DAP Function (1.2.1) (Op_Reports)
- System test reports in DAS internal representation (Op_Reports)

Processing - The following is a description of DAS Operator MMI Function (1.2.3.1) processing:

For each system control request and DAS Operator GUI based transaction encountered, the DAS Operator MMI Function responds in the following manner:

If a DAS Operator GUI based transaction is encountered, the function does the following:

- Transform DAS Operator GUI form inputs into internal DAS format
- Transform system operations reports in internal DAS format into GUI form presentation format and displayed for the DAS Operator
- Transform DAP responses to control and test commands into GUI representation for display to the operator

If a system control request is received, the function does the following:

- Orchestrate system control requests such that the minimum impact on overall DAS User services is experienced
- Send DAS equipment status and system control results to the DAP Function (1.2.1)

Outputs - The following are the outputs from the DAS Operator MMI Function (1.2.3.1) (refer to Figure 4-7):

- DAS Operator system status and test reports in GUI representation (DAS_Op_Info)
- DAS Operator system control and test commands in internal DAS representation for the DAP Function (1.2.1) (Op_CMDs)

Function Requirements - Table 4-15 contains a description of the formal processing requirements associated with the DAS Operator MMI Function (1.2.3.1) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb “shall”. Sentences not containing the verb “shall” are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-15 DAS Operator MMI Function (1.2.3.1) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
108	3.4.2.3	DARCM return link function shall include a local WSC man machine interface that permits complete operation of the WSC demand access equipment (including the DAP and DAB) from the WSC.
119	3.4.2.3	Each implementation of the DAS SGLT shall contain an MMI that will be used to control the DAS equipment located at the SGLT.
143	3.4.2.3	The MMI at the WSC SGLT shall be the Master Control Console for initiating start up, configuration, test and termination operations for the DAS equipment at all DAS SGLT installations.

4.1.2.3.2 TGBFS Controller Function (1.2.3.2)

Purpose - The role of the TGBFS Controller Function (1.2.3.2) is as follows:

- Provide the information to the TGBFS Function needed to support DA return services beamformer functions

Inputs - The following are the inputs to the TGBFS Controller Function (1.2.3.2) (refer to Figure 4-7):

- Specifications for each service in terms of beamformer parameters (Beam_Spec)
- TGBFS test request specifications (Beam_Spec)
- TGBFS equipment status reports (TGBFS_Status)
- TGBFS test reports (TGBFS_Status)

Processing - The following is a description of processing requirements associated with the TGBFS Controller Function (1.2.3.2):

For each DAR service configuration and system control request received, the TGBFS Controller Function responds in the following manner:

If a service configuration request is received, the function does the following:

- Accept specifications for service from the DAP Function (1.2.1) in terms of beamformer control parameters
- Transform service specifications into beamformer commands to control the beamformer equipment throughout DA return link services
- Transform raw status data from the TGBFS equipment into internal DAS status report format
- Transmit TGBFS status reports to the DAP Function (1.2.1)

If a system control request is received, the function does the following:

- Orchestrate system control request such that the minimum impact on overall DAS User services is experienced
- Send DAS equipment status and system control results to the DAP Function (1.2.1)

Outputs - The following are the outputs from the TGBFS Controller Function (1.2.3.2) (refer to Figure 4-7):

- TGBFS status reports (Beam_Status)
- TGBFS test reports (Beam_Status)
- TGBFS equipment commands (TGBFS_Config)
- TGBFS test commands (TGBFS_Config)

Function Requirements - Table 4-16 contains a description of the formal processing requirements associated with the TGBFS Controller Function (1.2.3.2) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb "shall". Sentences not containing the verb "shall" are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-16 TGBFS Controller Function (1.2.3.2) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
83	3.4.2.1	MAR link beamforming shall be under control of the DARCM function. The Control function sets distinct TDRSS-to-user direction cosines and beamforming modes for each IBU. Output from each IBU is an intermediate frequency (IF) waveform that is ultimately passed to a DA demodulator.
84	3.4.2.1	TGBFS shall generate status data that is passed to the DARCM function.

4.1.2.3.3 RLDRS Controller Function (1.2.3.3)

Purpose - The role of the RLDRS Controller Function (1.2.3.3) is as follows:

- Provide the information to the RLDRS Function needed to support DA return services demodulation and switching functions

Inputs - The following are the inputs to the RLDRS Controller Function (1.2.3.3) (refer to Figure 4-7):

- Specifications for each service in terms of demodulator and switching parameters (Demod/Switch_Spec)
- RLDRS test request specifications (Demod/Switch_Spec)
- RLDRS equipment status reports (RLDRS_Status)
- RLDRS test reports (RLDRS_Status)

Processing - The following is a description of RLDRS Controller Function (1.2.3.3) processing:

For each DAR service configuration and system control request received, the RLDRS Controller Function responds in the following manner:

If a service configuration request is received, the function does the following:

- Accept the specifications for each service from the DAP Function (1.2.1) in terms of demodulator (demodulator identifier and PN code) and switching parameters

- Transform service specifications into demodulator and switching commands to control the RLDRS equipment
- Transform raw status data from the RLDRS equipment into internal DAS status report format
- Transmit RLDRS status reports to the DAP Function (1.2.1)

If a system control request is received, the function does the following:

- Orchestrate system control request such that the minimum impact on overall DAS User services is experienced
- Send DAS equipment status and system control results to the DAP Function (1.2.1)

Outputs - The following are the outputs from the RLDRS Controller Function (1.2.3.3) (refer to Figure 4-7):

- RLDRS status reports in internal DAS representation (Demod/Switch_Status)
- RLDRS test reports (Demod/Switch_Status)
- RLDRS equipment service commands (RLDRS_Config)
- RLDRS test commands (RLDRS_Config)

Function Requirements - Table 4-17 contains a description of the formal processing requirements associated with the RLDRS Controller Function (1.2.3.3) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb "shall". Sentences not containing the verb "shall" are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-17 RLDRS Controller Function (1.2.3.3) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
106	3.4.2.3	DARCM return link function shall include setting demodulator control parameters and monitoring demodulator status.
107	3.4.2.3	DARCM return link function shall include IF switching and control of the data handling operations.

4.1.3 TGBFS Function (1.3)

Purpose - The role of the TGBFS Function (1.3) is as follows:

- Provide DA return link beamforming capabilities for more than 5 simultaneous DAS Users

Inputs - The following are the inputs to the TGBFS Function (1.3) (refer to Figure 4-3):

- DA return link service configuration data specifications (TGBFS_Config)
- Test commands (TGBFS_Config)
- Calibration vector from the existing MA return MABE (Cal_Vct)
- IF signal from the A/D Quad splitter in the existing MA return link (IF_Signal)

- Direction cosines at a 2 sec update rate for each DAR user (TGBFS_Config)

Processing - The following is a description of TGBFS Function (1.3) processing:

For each DAS User DAR service request and DAS Operator system control request, TGBFS Function responds in the following manner:

If a DAS User DAR service request is received from the DACDHS Function (1.2), the function does the following:

- Configure the TGBFS Function to meet the IBUG specifications generated by the beamformer controller in the DACDHS Function (1.2)
- Accept the 30 channels of IF signal
- Use the MABE calibration vector to calculate the delays to be applied to the 30 channels of IF signal from the A/D Quad Splitters
- Demultiplexed IF signals are transformed by an IBU into an analog form in preparation for demodulation and data recovery by the RLDRS Function (1.4)
- Send IBU output to the RLDRS Function (1.4)
- Construct service status reports and send to the DACDHS Function (1.2)
- Use the direction cosines to implement the return service for each DAR user

If a DAS Operator system control request is received, the function does the following:

- Assess the validity of the request
- Orchestrates DAS Operator system control, test, and configuration request activities among the DAS functions for each SGLT with a DAS equipment implementation

Outputs - The following are the outputs from the TGBFS Function (1.3) (refer to Figure 4-3):

- TGBFS equipment configuration status reports (TGBFS_Status)
- Test reports (TGBFS_Status)
- IF signals from the IBU (BF_Signal)

Function Requirements - Table 4-18 contains a description of the formal processing requirements associated with the TGBFS Function (1.3) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb “shall”. Sentences not containing the verb “shall” are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-18 TGBFS Function (1.3) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
79	3.4.2.1	The TGBFS shall interface with the existing WSC beamforming equipment of a single SGLT and permit generation of up to 50 MAR link antenna beams.
80	3.4.2.1	The TGBFS function shall accept digital data from the existing MA Beamforming Equipment (MABE) and distribute that data to a number of Independent Beamformer Units (IBUs).
81	3.4.2.1	The baseline TGBFS shall provide sufficient data distribution capacity to support 50 IBU Groups (consisting of five IBUs each) per SGLT. As an option, the TGBFS could include an additional Distribution Unit(s) to regenerate copies of the distributed data to support more beamformers.
82	3.4.2.1	TGBFS shall accept ancillary MABE data needed for beamforming and distribution to the IBUs. Such data includes the MABE generated calibration vector.

The TGBFS Function is not decomposed in this document since it a system that is being developed independently prior to the development of the DAS. Therefore, the document entitled Specification for the Third-Generation TDRSS MA Beamforming Subsystem Prototype Controller should be consulted for a decomposition of the TGBFS Function (1.3).

4.1.4 DA RLDRS Function (1.4)

Purpose - The role of the DA RLDRS Function (1.4) is as follows:

- Extract UP data from the DA return link signal
- Make one-way return Doppler measurements
- Provide recovered data for the formatting and routing function to the DAS Users

Inputs - The following are the inputs to the DA RLDRS Function (1.4) (refer to Figure 4-3):

- IF signal output from the TGBFS Function (1.3) (BF_Signal)
- DA return link service configuration data specifications (RLDRS_Config)
- Function test request specifications (RLDRS_Signal)

Processing - The following is a description of DA RLDRS Function (1.4) processing:

For each DAS User DAR service request and DAS Operator system control request, RLDRS Function responds in the following manner:

If DAS User DAR service request is received from the DACDHS Function (1.2), the function does the following:

- Install PN code used to isolate IF signals from the desired UP
- Extract UP message data from the IF signal via an assigned demodulator

- Send IF signal to one-way return Doppler extractor if range-rate tracking measurement is requested
- Raw data from more than one demodulator output is multiplexed for use by the DAB function
- Change mapping between the IBUs and demodulators (if the IF switching option is implemented in the DAS)
- Construct service status reports and send to the DACDHS Function (1.2)

If DAS Operator system control request is received, the function does the following:

- Assess the validity of the request
- Orchestrates DAS Operator system control, test, and configuration request activities among the DAS functions for each SGLT with a DAS equipment implementation

Outputs - The following are the outputs from the DA RLDRS Function (1.4) (refer to Figure 4-3):

- Multiplexed message and tracking data from the demodulators and Doppler extractors, respectively (RLDRS_Output)
- DA RLDRS equipment configuration status reports (RLDRS_Config)
- Test reports (RLDRS_Output)

Function Requirements - Table 4-19 contains a description of the formal processing requirements associated with the DA RLDRS Function (1.4) that have been extracted from the DASDOC. Each requirement is presented in terms of a sentence containing the verb “shall”. Sentences not containing the verb “shall” are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. An augmented version of the information present in the table can be found in Section 7.

Table 4-19 DA RLDRS Function (1.4) Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
77	3.4.2	A set of stationary MAR beams supports stationary users (e.g., buoys) to cover specific regions within the field-of-view of a TDRSS spacecraft. A set of demodulators shall be provided for each beam with each demodulator matched to a user-unique code. As in the first (tracking) scenario, full random access transmissions by TDRSS users are supported; however, because the users are fixed, no beam adjustments need to be implemented since different users are serviced within the same beam. This approach to sharing a single MA antenna beam among multiple users can provide TDRSS service to non-space users at minimal impact to the existing TDRSS infrastructure.
86	3.4.2.2	The subsystem shall accept the IF output from the beamformers, perform IF switching (option), signal demodulation, and data multiplexing prior to sending the data to the DA data handling system.
87	3.4.2.2	An IF switching function shall be an option in the DAR link implementation.
88	3.4.2.2	The IF switching function shall permit limited changes to the mapping between IBUs and DA Demodulators.
89	3.4.2.2	If an entire IBU Group fails, the IF switching function option shall permit re-mapping of IBUs within another IBU Group to the original set of DA demodulators.
90	3.4.2.2	The DA demodulators shall accept the IF signal generated by the IBUs and demodulate the user data contained within.
91	3.4.2.2	DA demodulator function shall include demodulation of MAR link signals.
92	3.4.2.2	DA demodulator function shall include measurement of MAR link signal Doppler in support of DA Doppler tracking (option).
93	3.4.2.2	DA demodulator function shall include acceptance of control information from, and passing of status information to, the DARCM function.
94	3.4.2.2	The DA data multiplexing function shall receive data from each of the NASA controlled DA demodulators connected to a single SGLT and multiplex the data for transmission to the DAB for further processing.

The DA RLDRS Function is not decomposed in this document since it a system that is being developed independently prior to the development of the DAS. Therefore, the document entitled TBD should be consulted for a decomposition of the DA RLDRS Function (1.4).

5. DAS Operations Requirements

The DAS operations requirements presented in this section were taken from the DASDOC. Table 5-1 lists the requirement number relative to all the DAS requirements, the section of the DASDOC from which the requirement was extracted, and the operations requirements. Each requirement is presented in terms of a sentence containing the verb "shall". Sentences not containing the verb "shall" are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. Another version of the information presented in the table with additional cross-referencing and requirements testing information is presented in Section 7 which contains a summary of all the DAS requirements presented in this document.

Table 5-1 DAS Operations Requirements

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
24	3.2.1.1	The entire DAF service shall appear, in general, to the NCC as a single user that makes frequent requests during periods when MAF services do not appear on the active schedule.
35	3.2.1.1	The NCC shall send a SHO to configure the MAF at the SGLT so that the DAF service is available.
51	3.3.1	DAF services shall not be allocated continuously. DAS Users requiring continuous services will be required to request a series of overlapping DAF services.
117	4.1.1.1	A DAS User with dedicated DAR equipment shall request that a dedicated service be setup on a continuous basis to relay UP data to the user POCC.
121	4.1.2	DAF operations shall provide the DA User with a one-way open data communications channel from the user POCC to the UP.
122	4.1.2	Two modes of operations shall exist for DAF operations. These modes are: • Instantaneous Command Mode – DAP passes through commands from the user POCC for uplink to the UP in real-time at the DAP • Delayed Command Mode – DAP buffers the commands provided by the user POCC for uplinking to the UP at a user specified time
123	4.1.3.1	DAR Unlimited Operations shall provide the user with the capability of receiving data from its UP on a continuous basis as long as the platform is in view of a TDRS.

Table 5-1 DAS Operations Requirements (Continued)

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
124	4.1.3.1	Unlimited Operations shall support several operations modes. These modes are as follows: • Single UP Mode – Users that require long periods of time to return data from a single UP (balloon, aircraft, buoy, etc.) can use this unlimited DAR service scenario option provided that their DAR equipment and UPs meet the following constraints: - UP has a dedicated beamformer and demodulator at one GT - UP is in constant view of at least one TDRSS spacecraft • Multiple UP Mode – Users that require long periods of time to return data from multiple UPs (balloons, aircraft, buoys, etc.) can use this unlimited DAR service scenario option provided that their DAR equipment and UPs meet the following constraints: - UPs have a dedicated beamformer and multiple demodulators - UPs are in constant view of one TDRSS spacecraft • UP Handover Mode – Users with dedicated DAS equipment can schedule continuous MAR service support for USATs as these platforms circle the Earth provided that their DAR equipment and UPs meet the following constraints: - UPs have dedicated beamformers and demodulators at more than one SLGT (all SLGTs for a full orbit or more of continuous data) - UP is in constant view of at least one TDRSS spacecraft
125	4.1.3.1	In order to terminate unlimited operation, the DA User shall use the termination mode of the DA Service Reconfiguration Operation described in the DASDOC.
126	4.1.3.2	The objective of the DAR Limited Operations shall be to provide DA Users with the capability of scheduling limited amounts of predetermined return service time. These DA service contact opportunities are scheduled with known start and stop times. This operational scenario provides the DA Users with a simple and cost effective means of scheduling return service time windows for routine data return collection activities such as data dumps, etc.
127	4.1.3.3.1	Polling is the sequential servicing of multiple UPs in the DAR service. This class of service shall be suitable for users who do not own, or wish to share, many sets of beamforming equipment. Essentially, one set of DAR equipment is periodically reconfigured so as to form an antenna beam on one of several UPs. For global coverage, it will be necessary to have three sets (one set per SGLT) of beamforming equipment: one in Guam, the other two at White Sands, NM (i.e., WSC).
128	4.1.3.3.2	The objective of the Polling DAR Operations shall be to provide single DA Users with the capability of scanning a set of USATs controlled by the user POCC and locking onto USAT MAR signals that are encountered in the polling scenario.
129	4.1.4	DA tracking operations shall allow the FDF or DAS User to schedule one-way Doppler tracking services. One-way DAR tracking scenarios resemble one-way DAR scenarios with the addition of Tracking Data Messages (TDMs) being sent to the FDF or DAS User. In order to schedule the one-way Doppler return, the DAS User must have a dedicated demodulator with a Doppler extractor in order to make the Doppler measurement.
137	4.1.5	SRO shall occur before or during the execution of the existing user's operations request depending upon the nature of the reconfiguration results being sought by the user.

Table 5-1 DAS Operations Requirements (Continued)

Req. No.	DASDOC Section No.	Requirements Extracted from DASDOC
138	4.2	Background operations shall support the overall operations of the DAS and are virtually transparent to DAS Users. The background operations scenarios represent DAS overhead operations that support the user scenarios with updated information for scheduling purposes.
139	4.2.1	TUT shall be determined by the NCC each day when the schedule for a ten-day window (starting on the current day) has been assessed. TUT represents all of the time on the NCC schedule when MAF and MAR services are not scheduled. Once the daily schedule update has been finalized, the NCC sends the DAS the TUT schedule for that ten day window. This message flow is currently implemented as an Internet e-mail transaction. The unscheduled MAF and MAR services become the DAF and DAR time slots that are presented to the DA Planning Tool for DA User scheduling opportunities.
140	4.2.2	The FDF computes the SVs of the UPs and TDRSS satellites for various purposes. This information shall be provided to the DAS as SV updates are available from the FDF.
141	4.2.3	The DAP shall constantly monitor the status of the DAS equipment by polling for and collecting status information from each of the DAS subsystems.
145	4.1.3.3.1	The beamformer and the acquisition time of the demodulator shall dictate the maximum polling update rate. The TGBFS beamformer will allow for one-second updates, and a typical demodulator will take a few seconds to acquire a signal.
147	4.1.3.3.1	In the event that a user satellite beacon is detected, the polling process shall stop and the DA service is now dedicated to that particular user satellite.
148	4.2.4	The DAS system shall allow for contingency operations such as non-user initiated DA service cancellations, acknowledgements of messages received, etc.
150	4.3.1	Start Up Operations shall provide the Master DAS Operator at one WSC SGLT with the capability of starting the DAS equipment at all the SLGTs.
151	4.3.2	DAS Configuration Operations shall provide the Master DAS Operator with the capability to modify system configuration files to account for equipment added to or removed from the DAS.
152	4.3.3	Termination Operations shall provide the Master DAS Operator with the capability of shutting down the DAS equipment at all SGLTs in an orderly fashion.
153	4.3.4	Termination Operations shall provide the DAS Operator at a specific SGLT with the capability of shutting down the DAS equipment at that site in an orderly fashion.

6. DAS States and Modes

This section contains a description of the temporal behavior of the DAS in terms of states and modes. In addition to this, the distribution of the DAS states and modes among the members of the DAS function hierarchy (shown in Figure 4-2) is presented. DAS states and modes are related to DA requirements through the function requirements presented in Section 4.

6.1 States and Modes Descriptions

DAS states characterize the major time-dependent characteristics of the system. Each state presents a different aspect of system existence that encompasses orchestrated behavior of subsets of the total DAS functionality. Some states are subdivided into modes. The modes focus on more detailed aspects of system functionality that occur within a state. The five states that describe the operational characteristics of the DAS are as follows:

- DAS Master Control State
- Input Monitor State
- Planning State
- Resource Allocation State
- User Operations State

Transitions between these states are governed by external stimuli and actions that occur in other system states. External stimuli consist of DAS User and operator requests for information, DAS services, and system maintenance activities. Figure 6-1 shows a state transition diagram of the DAS. The symbols and text used to construct this figure have the following interpretations:

- Each rectangle represents one of the five DAS states.
- The rectangles are labeled with the name of each state and the section of this document that describes the state.
- The rectangles are connected by arrows indicating the direction of the allowed transitions between the DAS states.
- Arrows not connecting rectangles represent external stimuli accepted by the DAS.
- External actions can directly or indirectly trigger state transitions.
- Each arrow has a condition and action description associated with it in the form of a transition label.
- The transition label contains two lines of text separated by a horizontal line with the following characteristics:

    1. the upper line of text identifies a condition that prevails in the DAS at the time of the transition, and
    2. the lower line of text identifies the action taken in the resulting state transition.

Figure 6-1 represents DAS state transition sequences as viewed by one DAS User. For example, when the system is on-line (i.e., supporting DAS User requests), one user might be exercising the DAS in the Planning State while a second user is simultaneously exercising it in the User Operations State. Each of the two DAS Users perceives that the system is in a different state

based on time and request specification differences between them. The DAS Master Control State is unique in this respect in that the system is off-line (i.e., supporting only DAS Operator requests) and not accessible to the DAS Users. Only the DAS Operator has access to system in this state. Therefore, the state transition diagram cannot be viewed as a temporal sequence of state transitions that are restricted to the realization of one state at a time for all DAS Users. Instead, different states can be realized simultaneously by more than one user, which is a reflection of the distributed and multitasking nature of the DAS.

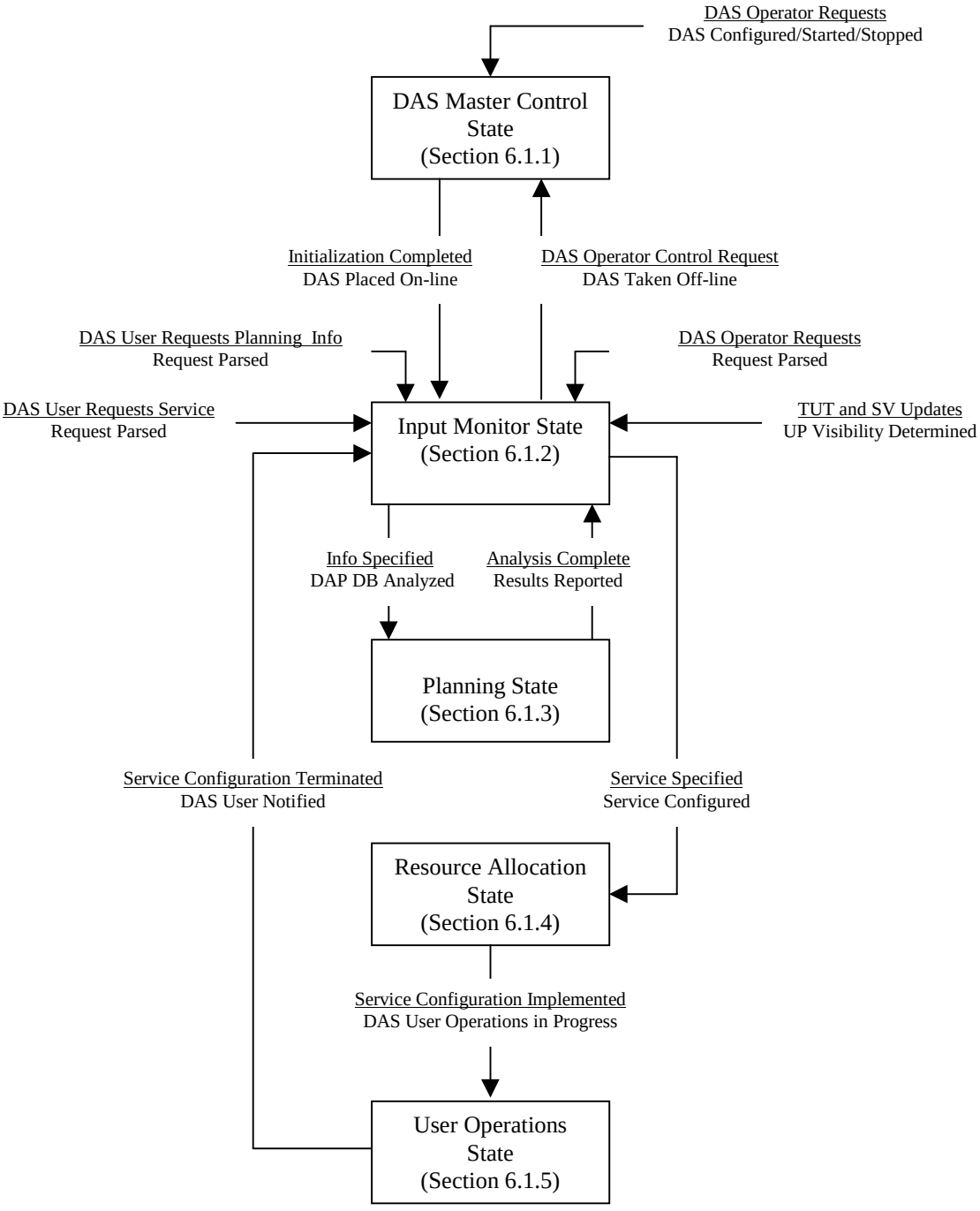

Figure 4-1 DAS State Transition Diagram

Each of the states shown in Figure 6-1 is described in detail in the following sections.

6.1.1 DAS Master Control State

The Master Control State is encountered by the Master DAS Operator located at one of the WSC SGLTs upon cold-starting or warm-staring the DAS. This state is automatically realized on system coldstart and the DAS Operator at one WSC SGLT is presented with a choice of the following modes:

- Startup
- Configuration Mode
- Test Mode
- Terminate Mode

The following sections describe these modes. The DAS is off-line to DAS Users throughout the execution of all four of these modes

6.1.1.1 Startup Mode

During the execution of this mode, the designated configuration file parameters are installed as the current operations parameters. This mode triggers the transition from the DAS Master Control State to the Input Monitor State where the system is placed on-line for DAS Users to begin interacting with the DAS. DAS User services are not available in this mode.

6.1.1.2 Configuration Mode

This mode allows the Master DAS Operator to reconfigure the DAS in terms of equipment and operations parameters that remain constant for the duration of extended period of DAS operations. In this mode, the DAS has not yet been placed on-line. Only the DAS Operator can interact with the system to edit configuration files. For example, when equipment such as additional beamformers and demodulators are added to the DAS, their existence must be registered with the system in order for them to be recognized by the system when it is placed on-line. Exiting this mode leaves the system off-line in the Master Control State. DAS User services are not operational in this mode.

6.1.1.3 Test Mode

This mode allows the Master DAS Operator to check the performance of segments of the system without placing the system on-line. During the execution of this mode, the existing configuration file parameters are installed as the current system configuration parameters. Exiting this mode leaves the system off-line in the Master Control State. DAS User services are not operational in this mode. DAS Operators located at the remaining two SLGTs receive status reports from the equipment located at their locations.

6.1.1.4 Terminate Mode

During the execution of this mode, the DAS is brought to an orderly shutdown by closing all files and gracefully terminating system activities that are in progress. DAS User services are not operational in this mode.

6.1.2 Input Monitor State

When the DAS enters this state, the system is on-line and available for use by DAS Users and operator. Some DAS interactions with external entities and internal system events will induce transitions into, and out of this state. Other background interactions will result in the DAS remaining in the Input Monitor State upon the completion of background processing.

The Input Monitor State is a focal point for handling DAS User and operator requests while the system is on-line. Each user request induces the appropriate transitions into other states depending upon the nature of the requests. When the DAS completes the operations in the induced states, the system returns to the Input Monitor State. The DAS Operator can request to take the system off-line, returning it to the Master Control State. Therefore, the Input Monitor State serves as a starting and ending state for DAS User related activities.

The modes associated with this state are as follows:

- User Request Mode
- Operator Request Mode
- Scheduling Database Update Mode

The following sections describe each of these modes.

6.1.2.1 User Request Mode

This mode pertains to all of the actions associated with processing DAS User and operator requests while the system is on-line. When the system enters this mode, the DAS User requests are parsed and reduced to an internal DAS representation that is then used to initiate the processing associated with requested state. This mode is active as long as DAS User requests are queued for processing.

6.1.2.2 Operator Request Mode

This mode is activated when the DAS Operator interacts with the system while the DAS is on-line. Operator requests, such as a DAS run-time system status requests, are parsed and processed. This mode is active as long as DAS Operator requests are queued for processing. The operator requests will not interfere with the DAS User services that are scheduled or in progress.

6.1.2.3 Scheduling Database Update Mode

This mode is activated when TUT schedules are received from the NCC or when state vector updates for the TDRSS spacecraft and USATs are received from the FDF. Once the system has entered this mode, the DAP database is updated to reflect new UP visibility windows based on the information updates. Once this background activity is complete, this mode is no longer operational.

6.1.3 Planning State

This state is entered from the Input Monitor State. DAS User requests for planning information that are parsed in the Input Monitor State incite the transition into the Planning State. Once the Planning State has been realized, analysis of the DAP database proceeds in order to obtain the information specified in the request. The system returns to the Input Monitor State when the analysis is complete and a planning report has been generated for the user request.

6.1.3.1 Information Mode

The information mode is activated when a DAS User enters a request for planning information that will be used to specify DAS service requests. This mode is terminated when there are no more DAS User requests for planning information queued to be processed and all the responses have been presented to the DAS Users.

6.1.3.2 Service Request Mode

This mode is activated when a DAS User request for service is entered into the system. This mode is terminated when there aren't any more DAS User requests for services that are queued to be processed and all of the responses for the success or failure of the service allocation have been presented to the DAS User.

6.1.4 Resource Allocation State

This state is induced as the result of a valid user request for DAS services being processed by the Input Monitor State. This state supports the identification and reservation of DAS return and existing MA equipment chains at a SGLT that meet the DAS service request specification. The type of equipment resource allocation depends on the specific nature of the DAS User request. At this time, the service is registered by the DAS as a service configuration and endures until the service is terminated in the User Operations State. The Resource Allocation State is terminated after the equipment chains have been defined and reserved for the future implementation of the requested service. The Resource Allocation State consists of the following modes:

- DAF Mode
- DAR Mode
- DAS Tracking Mode

The following sections describe these modes.

6.1.4.1 DAF Service Mode

This mode is activated when the DAS User has requested a DAF service. The resource allocation process associated with this mode is managed by the NCC. Therefore, when the system is in this mode, SHO-like messages are sent from the DAP to the NCC in order to allocate resources at the appropriate SGLT for an MAF service according to the time and communications constraints specified by the DAS User request. This mode is terminated when the MAF service has been registered on the NCC active schedule.

6.1.4.2 DAR Service Mode

This mode is activated when the DAS User has requested a DAR service. The resource allocation process associated with this mode is managed by the DAP. The equipment chains in the TGBFS and RLDRS are assigned in a non-conflicting manner to support each DAR service request. If a one-way return Doppler-tracking request has been made, a Doppler extractor will be allocated to the equipment chain in addition to the beamforming and demodulator equipment. This mode is terminated when the DAR service has been registered by the DAP and is realized from the perspective of resources allocation.

6.1.5 User Operations State

This state is realized when a service request is implemented using the allocated equipment chains that were reserved for that request in the Resource Allocation State. The beamforming and demodulator equipment are configured to realize the DAF or DAR service. The DAS User is able to send commands/data to, and receive data from the UP, respectively. This state is terminated when the DAF or DAR service has ended. The end of the service triggers the transition to the Input Monitor State.

6.2 Distribution of DAS Functions Among States and Modes

The realization of a given DAS state and mode in general involves a subset of system functions. Since the DAS functions identified in Section 4 are decomposed from the single, top-level DAS Function (1.0), which represents the entire system, this progenitor function participates in all of the DAS states and modes. As the top-level function is subjected successive levels of function decomposition, the resolution of the general DAS Function (1.0) into specialized function subsets of that are restricted to one or several DAS states and modes. Table 6-1 shows the relationship of functions within the DAS hierarchy to the DAS states and modes. In general, higher level functions within the hierarchy shown in Figure 4-2 participate in more states and modes than their descendents spawned through repeated applications of function decomposition.

Table 5-1 Distribution of the Members of the DAS Function Hierarchy among the DAS States and Modes

Function	Master Control State				Input Monitor State			Planning State		Resource Allocation State		User Operations State
	Reconfiguration Mode	Start-up Mode	Test Mode	Terminate Mode	User Request Mode	Operator Request Mode	Scheduling DB Update Mode	Information Mode	Service Request Mode	DAF Service Mode	DAR Service Mode	
DAS (1.0)	x	x	x	x	x	x	x	x	x	x	x	x
Planning Tool (1.1)					x			x	x			
DACDHS (1.2)	x	x	x	x	x	x	x	x	x	x	x	x
DAP (1.2.1)	x	x	x	x	x	x	x	x	x	x	x	x
Service Request Handler (1.2.1.1)	x	x	x	x	x	x	x	x	x	x	x	x
DAF Service Manager (1.2.1.2)		x	x	x						x		x
DAR Service Manager (1.2.1.3)		x	x	x							x	x
Service Resource Analyzer (1.2.1.4)		x	x	x	x		x	x	x			
DAB (1.2.2)		x	x	x	x					x	x	x
DAB Service Manager (1.2.2.1)		x	x	x	x					x	x	x
Data Buffering (1.2.2.2)		x	x	x	x					x	x	x

Table 5-1 Distribution of the Members of the DAS Function Hierarchy among the DAS States and Modes (Continued)

Function	Master Control State				Input Monitor State			Planning State		Resource Allocation State		User Operations State
	Reconfiguration Mode	Start-up Mode	Test Mode	Terminate Mode	User Request Mode	Operator Request Mode	Scheduling DB Update Mode	Information Mode	Service Request Mode	DAF Service Mode	DAR Service Mode	
Data Formatting (1.2.2.3)		x	x	x	x					x	x	x
Data Routing (1.2.2.4)		x	x	x	x					x	x	x
DACDHS (1.2.3)		x	x	x		x					x	x
DAS Operator MMI (1.2.3.1)		x	x	x		x						
TGBFS Controller (1.2.3.2)		x	x	x							x	x
RLDRS Controller (1.2.3.2)		x	x	x							x	x
TGBFS (1.3)		x	x	x							x	x
DA RLDRS (1.4)		x	x	x							x	x

7. Summary of DAS Architectural, Functional, and Operations Requirements

Table 7-1 is a summary and cross-reference of the all the DAS requirements presented in Sections 3, 4, and 5. Each requirement in the table has been given a number for traceability purposes. The section number and title of the location in the DASDOC from which the requirement is extracted is presented in the table for each requirement. Each requirement is presented in terms of a sentence containing the verb "shall". Sentences not containing the verb "shall" are presented for informational purposes in order to place the requirement within the context that it is presented in the DASDOC. The requirement type indicates whether the requirement belongs to the architectural (A), functional (F), or operational (O) categories of Sections 3, 4, and 5 of this document, respectively. The function identifiers used in Section 4 of this document have been included in the table for cross-referencing purposes. Architectural and operational requirements have "Not Applicable" (N/A) entered in the function identifier column.

The categories of testing that will be used to verify that the requirement has been met is included in Table 7-1. The test categories are analysis, demonstration, inspection, and test. The following are the definition of each of the categories:

- Analysis (A) is the method of verification which consists of comparing hardware or software design with known scientific and technical principles, technical data, or procedures and practices to validate that the proposed design will meet the specified functional or operational requirements.
- Demonstration (D) is the method of verification where qualitative versus quantitative validation of a requirement is made during a dynamic test of equipment. In general, software functional requirements are validated by demonstration since the functionality must be observed through some secondary medium.
- Inspection (I) is the method of verification to determine compliance with specification requirements and consists primarily of visual observations or mechanical measurements of equipment, physical location, or technical examination of engineering support documentation.
- Test (T) is the method of verification that will measure equipment performance under specific configuration load conditions and after the controlled application of known stimuli. Quantitative values are measured, compared against previous predicted success criteria, and evaluated to determine the degree of compliance.

Table 7-1 DAS Requirements Summary and Cross-Reference

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
1	3.0	DAS Description	The DAS shall expand the capabilities of the current SGLT MAR beamforming system to handle an increased number of return service users beyond the current limit of five.	F	1.0	D
2	3.0	DAS Description	The MAR expansion shall be accomplished by the use of new beamforming equipment and the introduction of more demodulators to accommodate the increased TDRSS user load associated with the DAS.	F	1.0	D
3	3.0	DAS Description	DAS forward service allocation shall occur at those times when the NCC active schedule does not have MAF requests already occupying the scheduled time slots.	F	1.0	D
4	3.0	DAS Description	The DAS shall coordinate forward service requests with the NCC.	F	1.0	I
5	3.0	DAS Description	Return service requests shall be handled directly by the DAS, which controls the new beamforming and demodulator assets.	F	1.0	D
6	3.1	DAS Functional Architecture Overview	The elements that augment the existing MA system to form the DAS shall be: • Third Generation Beam Forming System (TGBFS) • DA Return Link Data Recovery Subsytem (RLDRS) • DA Control Data Handling System (DACDHS) Function	A	N/A	I
7	3.1	DAS Functional Architecture Overview	Unlike the current beamforming system (constrained to support a maximum of five simultaneous MAR users per TDRS satellites), the TGBFS shall be capable of being continually expanded to accommodate a potential increase in the number (up to 50) of simultaneous DAS return service users.	A	N/A	I
8	3.1	DAS Functional Architecture Overview	The capability of modularly increasing the number of beamformers in the DAS design shall be coupled with the parallel capability of increasing the number of demodulators required to extract the data from each additional user's return signal.	A	N/A	I
9	3.1	DAS Functional Architecture Overview	The TGBFS and the RLDRS shall operate in conjunction with the existing MAR service chains located in each SGLT to support DAR services.	A	N/A	I
10	3.1	DAS Functional Architecture Overview	The DARCM function shall control the return service DAS SGLT equipment configuration.	F	1.2.3	D

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
11	3.1	DAS Functional Architecture Overview	The DARCM function shall configure the beamforming and demodulation functions according to the demands of the DAS return service requests.	F	1.2.3	D
12	3.1	DAS Functional Architecture Overview	The DAS return service requests shall be sent to the DAP from the DA User's POCC.	F	1.2.1	D
13	3.1	DAS Functional Architecture Overview	The DAP shall determine the spatial and temporal constraints associated with a DAS return service request.	F	1.2.1	D
14	3.1	DAS Functional Architecture Overview	The DAP shall send the specifications to the DARCM function to be translated into return service equipment configuration commands.	F	1.2.1	D
15	3.1	DAS Functional Architecture Overview	The DAP shall configure the DAB function to manage the buffering and routing of forward and return service commands and data between the UPs to the associated user POCCs.	F	1.2.1	D
16	3.1	DAS Functional Architecture Overview	The Closed Nascom IP Operational Network (IOnet) shall be used to transfer service request information, commands, and data between the DAS User and the DAP and DAB functions.	A	N/A	I
17	3.1	DAS Functional Architecture Overview	The DAP shall perform the navigation computations needed to assign the forward and return services via the propagation of satellite state vectors supplied to the DAP on a regular basis by the FDF.	F	1.2.1	D
18	3.1	DAS Functional Architecture Overview	UP and TDRSS spacecraft position information shall be maintained by the DAP.	F	1.2.1	D
19	3.2	DAS Services	Two one-way services are defined for the DAS. These are the one-way DA Forward (DAF) and one-way DA Return (DAR) services. The DAF shall allow commands and data to be sent from the user POCC to the UP. For example, the DAS User can construct combined forward and return services (two-way).	F	1.2	D
20	3.2	DAS Services	The DAR service shall allow the user POCC to receive data sent from the UP.	F	1.2.2	D

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
21	3.2	DAS Services	The DAF and DAR services shall be the elementary building blocks from which more complicated DA User operations scenarios are made.	F	1.2.1	D
22	3.2	DAS Services	The DA User shall be allowed to schedule the one-way DAF and DAR services in the following ways (depending on the user's mission operations objectives): • separately, • with overlapping time windows, or • simultaneously	F	1.2.1.1	D
23	3.2.1.1	DAF Service	The DAF service shall be essentially a MAF forward service that has been appropriated through the DAS allocation process.	F	1.2.1.2	D
24	3.2.1.1	DAF Service	The entire DAF service shall appear, in general, to the NCC as a single user that makes frequent requests during periods when MAF services do not appear on the active schedule.	O	N/A	D
25	3.2.1.1	DAF Service	Each day, the NCC shall assess the amount of TUT that is available for the next ten days and broadcasts the TUT schedule via the Internet to TDRSS users.	F	1.2.1.4	D
26	3.2.1.1	DAF Service	The MAF TUT becomes the DAF scheduling opportunities and shall be the time available for scheduling DAF services for DAF users.	F	1.2.1	D
27	3.2.1.1	DAF Service	TUT time shall be allotted to DAS Users in intervals that are no larger than the interval of time separating two consecutive MAF time slots on the active schedule.	F	1.2.1.4	D
28	3.2.1.1	DAF Service	In order to establish a DAF service, the user POCC shall request the time based on the MAF TUT options monitored by the DAP.	F	1.2.1.4	D
29	3.2.1.1	DAF Service	Users shall be guided through the selection process by means of the DA Planning Tool located at the user POCC that interfaces with the DAP.	F	1.1	D
30	3.2.1.1	DAF Service	After a suitable range of MAF times are identified with the Planning Tool, the DAS User shall request the DAP to establish the DAF service.	F	1.2.1.1	D
31	3.2.1.1	DAF Service	DAF services shall be allocated on a first come, first served basis for DAS Users.	F	1.2.1.1	D
32	3.2.1.1	DAF Service	The DAF service shall use the existing SGLT MAF equipment.	A	N/A	I

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
33	3.2.1.1	DAF Service	DAS User requests for the DAF services shall be automatically coordinated through the NCC.	F	1.2.1.2	D
34	3.2.1.1	DAF Service	Requests, similar to Scheduling Orders (SHOs), shall be sent from the DAP to the NCC in order to configure the GT equipment chain to support the DAP requested DAF service.	F	1.2.1.2	D
35	3.2.1.1	DAF Service	The NCC shall send a SHO to configure the MAF at the SGLT so that the DAF service is available.	O		D
36	3.2.1.1	DAF Service	Once the DAF service is established, user commands and data shall be sent directly to the DAB for formatting and buffering for immediate uplinking to the UP.	F	1.2.2	D
37	3.2.1.1	DAF Service	The DAS User shall have the choice to have the command data buffered at the DAB for a delayed uplinking at a specified time after the DAF service begins.	F	1.2.2	D
39	3.2.1.2	DAR Service	The upper limit on the number of DAR users shall be determined by the number of DA beamformers and demodulators present in the SGLT.	A	N/A	I
40	3.2.1.2	DAR Service	Increasing the number of beamformers and demodulators in the TGBFS and DA RLDRS, respectively, shall increase the size of the equipment pool from which DAR service equipment chains can be constructed for simultaneous DAR users.	A	N/A	I
41	3.2.1.2	DAR Service	There shall be two categories of DAR equipment: • dedicated equipment consisting of beamformers and demodulator owned by specific DAS Users, and • equipment consisting of a pool of NASA supplied beamformers and demodulators that are shared by DAS Users.	A	N/A	I
42	3.2.1.2	DAR Service	The DAR service shall use some existing MAR and new DAS SGLT equipment.	A	N/A	I
43	3.2.1.2	DAR Service	The DAP shall choose DAS beamforming and demodulator equipment if the option arises to use new or existing equipment.	F	1.2.1.3	D
44	3.2.1.2	DAR Service	If the existing equipment is chosen in place of DAS resources, the scheduling of the equipment shall occur through NCC and is transparent to the DAS User.	F	1.2.1.3	D

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
45	3.3.1	DAF Service Characteristics	The DAS shall decide which TDRS will be used for most service requests.	F	1.2.1.4	D
46	3.3.1	DAF Service Characteristics	Service times shall be selected by the DAS for DAS Users with flexible service requirements.	F	1.0	T
47	3.3.1	DAF Service Characteristics	Each individual DAF service duration shall be limited by the length of the MAF TUT intervals in the NCC active schedule.	F	1.2.1.4	D
48	3.3.1	DAF Service Characteristics	There shall be only two DAF user priorities, normal and emergency.	F	1.2.1.2	D
49	3.3.1	DAF Service Characteristics	Under normal operating conditions, DAF services shall be allocated on a first come, first served basis.	F	1.2.1.2	D
50	3.3.1	DAF Service Characteristics	The DAP shall place emergency DAF service requests at the beginning of the service request queue.	F	1.2.1	D
51	3.3.1	DAF Service Characteristics	DAF services shall not be allocated continuously. DAS Users requiring continuous services will be required to request a series of overlapping DAF services.	O	N/A	D
52	3.3.1	DAF Service Characteristics	DAF handover shall be scheduled by the DAS User as a series of consecutive DAF requests spanning two or more different TDRS visibility time windows.	F	1.2.1.2	D
53	3.3.2	DAR Service Characteristics	DAS Users shall have a choice to install their own dedicated DAR beamforming and demodulator equipment.	A	N/A	I
55	3.3.2	DAR Service Characteristics	If DAS Users do not choose to provide their own beamforming and demodulator equipment, then the DAP shall choose an available set of TDRSS dedicated equipment for the user service	F	1.2.1.3	D
56	3.3.2	DAR Service Characteristics	DAS Users shall be capable of routing their own data independent of the DAB.	A	N/A	I
57	3.4	DA Functions in Detail	The elements of the DAS consist of the existing functions of the TDRSS MA services and the new DA functions that shall be added to support DA operations.	A	N/A	I

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
58	3.4	DA Functions in Detail	The following functions shall support the DAS operations capabilities: • DAF Service Function • DAR Service Function • DA Planning Tool Function	F	1.0	D
59	3.4.1	DAF Service Function	Implementation of DAF service shall be based on the existence of a DA forward link control/data handling function that includes the following DA functions: • DAP Function DAB Function	F	1.2	D
60	3.4.1.1	DAP Function	The forward link DAP function shall provide the primary control interface between the WSC DA services, the DA Users, and NCC.	F	1.2.1	D
61	3.4.1.1	DAP Function	The DAP shall implement both forward and return link DA service control in a manner that minimizes the complexity of DAS User interfaces.	F	1.2.1	A
62	3.4.1.1	DAP Function	DAP shall receive TUT daily messages from NCC. This information permits the sharing of scheduled and DA service on a single SGLT by allowing the DAP to avoid requesting DA service during previously scheduled service intervals.	F	1.2.1.4	D
63	3.4.1.1	DAP Function	DAP shall receive and acknowledge DA User requests for forward link DA service and user configuration messages necessary to control DA service.	F	1.2.1	D
64	3.4.1.1	DAP Function	DAP shall calculate user spacecraft visibility intervals and determine user spacecraft to TDRSS spacecraft line of sight for omni-directional antenna services.	F	1.2.1.4	D
65	3.4.1.1	DAP Function	DAP shall select an appropriate TDRSS spacecraft for service.	F	1.2.1.4	D
66	3.4.1.1	DAP Function	The DAP shall accept UP visibility schedules provided by DAS Users.	F	1.2.1.4	D
67	3.4.1.1	DAP Function	The DAS shall set up DAF service by transmitting service requests to the NCC.	F	1.0	D
68	3.4.1.1	DAP Function	DAP shall report status to the user and the NCC.	F	1.2.1	D
69	3.4.1.2	DAB Function	The DAB for the DAF link shall support acceptance of forward link DA data from DA Users.	F	1.2.2.3	D

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
70	3.4.1.2	DAB Function	The DAB for the DAF link shall support forward link DA data buffering. On the forward link, user data may either be passed through the DAB in real time at the time of service initiation or stored within the DAB prior to service initiation.	F	1.2.2	D
71	3.4.1.2	DAB Function	The DAB for the DAR link shall support return data link buffering. If the user is lost or the user decides to go off-line during DAR operations, data will be buffered by the DAB function.	F	1.2.2.2	D
72	3.4.1.2	DAB Function	The DAB for the DAR link shall support formatting of return link data.	F	1.2.2.3	D
73	3.4.1.2	DAB Function	The DAB for the DAR link shall support routing of return link data.	F	1.2.2.4	D
74	3.4.2	DAR Service Function	The DAR implementation (software augmentation to the current WSC and Guam SGLT infrastructures) shall require development and deployment of new hardware.	A	N/A	I
75	3.4.2	DAR Service Function	Return DA shall accommodate up to 50 users. Depending on the number of users, each user may be provided continuous service via a dedicated, rather than demand access service.	A	N/A	I
76	3.4.2	DAR Service Function	TDRSS MAR antenna beam tracks user spacecraft, thus providing the opportunity for user spacecraft to return data any time they are in view of a TDRS. If three widely spaced TDRSs are used, continuous coverage can be provided. A key requirement for this approach shall be that enough beamformers and demodulators be available at WSC to serve all DA Users. Since WSC equipment chains are dedicated to each TDRSS spacecraft, the possibility of an uneven distribution of users in view to a specific TDRSS spacecraft means that the total number of required beamformers and demodulators exceeds the number of users.	A	N/A	I

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
77	3.4.2	DAR Service Function	A set of stationary MAR beams supports stationary users (e.g., buoys) to cover specific regions within the field-of-view of a TDRSS spacecraft. A set of demodulators shall be provided for each beam with each demodulator matched to a user-unique code. As in the first (tracking) scenario, full random access transmissions by TDRSS users are supported; however, because the users are fixed, no beam adjustments need to be implemented since different users are serviced within the same beam. This approach to sharing a single MA antenna beam among multiple users can provide TDRSS service to non-space users at minimal impact to the existing TDRSS infrastructure.	F	1.4	D
78	3.4.2	DAR Service Function	The key elements/functions (refer to Figure 3-1 of DASDOC) of the DAR architecture shall be as follows: • TGBFS Function • RLDRS Function • DA Control/Data Handling System (DACDHS) Function	A	N/A	I
79	3.4.2.1	TGBFS Function	The TGBFS shall interface with the existing WSC beamforming equipment of a single SGLT and permit generation of up to 50 MAR link antenna beams.	F	1.3	D
80	3.4.2.1	TGBFS Function	The TGBFS function shall accept digital data from the existing MA Beamforming Equipment (MABE) and distribute that data to a number of Independent Beamformer Units (IBUs).	F	1.3	D
81	3.4.2.1	TGBFS Function	The baseline TGBFS shall provide sufficient data distribution capacity to support 50 IBU Groups (consisting of five IBUs each) per SGLT. As an option, the TGBFS could include an additional Distribution Unit(s) to regenerate copies of the distributed data to support more beamformers.	F	1.3	D
82	3.4.2.1	TGBFS Function	TGBFS shall accept ancillary MABE data needed for beamforming and distribution to the IBUs. Such data includes the MABE generated calibration vector.	F	1.3	D

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
83	3.4.2.1	TGBFS Function	MAR link beamforming shall be under control of the DARCM function. The Control function sets distinct TDRSS-to-user direction cosines and beamforming modes for each IBU. Output from each IBU is an intermediate frequency (IF) waveform that is ultimately passed to a DA demodulator.	F	1.2.3.2	D
84	3.4.2.1	TGBFS Function	TGBFS shall generate status data that is passed to the DARCM function.	F	1.2.3.2	D
85	3.4.2.2	RLDRS Function	The RLDRS shall consist of at least the following elements (demodulators, and multiplexer) needed to recover the MAR link data after beamforming.	A	N/A	I
86	3.4.2.2	RLDRS Function	The subsystem shall accept the IF output from the beamformers, perform IF switching (option), signal demodulation, and data multiplexing prior to sending the data to the DA data handling system.	F	1.4	D
87	3.4.2.2	RLDRS Function	An IF switching function shall be an option in the DAR link implementation.	F	1.4	D
88	3.4.2.2	RLDRS Function	The IF switching function shall permit limited changes to the mapping between IBUs and DA Demodulators.	F	1.4	D
89	3.4.2.2	RLDRS Function	If an entire IBU Group fails, the IF switching function option shall permit re-mapping of IBUs within another IBU Group to the original set of DA demodulators.	F	1.4	D
90	3.4.2.2	RLDRS Function	The DA demodulators shall accept the IF signal generated by the IBUs and demodulate the user data contained within.	F	1.4	D
91	3.4.2.2	RLDRS Function	DA demodulator function shall include demodulation of MAR link signals.	F	1.4	D
92	3.4.2.2	RLDRS Function	DA demodulator function shall include measurement of MAR link signal Doppler in support of DA Doppler tracking (option).	F	1.4	D
93	3.4.2.2	RLDRS Function	DA demodulator function shall include acceptance of control information from, and passing of status information to, the DARCM function.	F	1.4	D
94	3.4.2.2	RLDRS Function	The DA data multiplexing function shall receive data from each of the NASA controlled DA demodulators connected to a single SGLT and multiplexes the data for transmission to the DAB for further processing.	F	1.4	D
95	3.4.2.3	DACDHS Function	DACDHS function shall provide control to the return link DA system and support return link DA data handling.	F	1.2	D

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
96	3.4.2.3	DACDHS Function	The DAP shall provide the primary control interface between the WSC DA services and the DA customers and NCC. The DAP implements both forward and return link DA service control in order to provide a minimum number of interfaces to the user. (Initially, the DAP will support the return link, with forward link control added later.)	F	1.2.1	D
97	3.4.2.3	DACDHS Function	DAP return link function provided shall include receipt of user DA return service control messages including service parameters and data handling instructions (e.g., real time return vs. data buffering).	F	1.2.1.3	D
98	3.4.2.3	DACDHS Function	DAP return link function provided shall include high level control messaging to/from the return DA equipment via NCC.	F	1.2.1.3	D
99	3.4.2.3	DACDHS Function	DAP return link function provided shall include high level control of the Demand Access Buffer in order to configure DA return link data handling	F	1.2.1.3	D
100	3.4.2.3	DACDHS Function	DAP Return link function provided shall include return DA status reporting to the DA customer and NCC.	F	1.2.1.1	D
101	3.4.2.3	DACDHS Function	The DAB function shall support data handling for both forward and return link DA services.	F	1.2.2.1	D
102	3.4.2.3	DACDHS Function	DA return link functions supported by the DAB shall include formatting/routing of DA return link data to DA customers. Return link data includes both user spacecraft generated data and (optionally) tracking data messages from the DA demodulators.	F	1.2.2	D
103	3.4.2.3	DACDHS Function	DA return link functions supported by the DAB shall include return link DA data buffering. On the return link, customer data may be routed to the customer (via the closed IOnet) in real time or, for users having limited amounts of data, data may be stored for later retrieval by the customer.	F	1.2.2.2	D
104	3.4.2.3	DACDHS Function	The return link DARCM function shall implement all control and status monitoring for the return link DA equipment within a single SGLT.	F	1.2	D
105	3.4.2.3	DACDHS Function	DARCM return link function shall include setting/monitoring beamforming mode, sending direction cosines to each IBU, and monitoring beamformer status.	F	1.2	D

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
106	3.4.2.3	DACDHS Function	DARCM return link function shall include setting demodulator control parameters and monitoring demodulator status.	F	1.2.3.3	D
107	3.4.2.3	DACDHS Function	DARCM return link function shall include IF switching and control of the data handling operations.	F	1.2.3.3	D
108	3.4.2.3	DACDHS Function	DARCM return link function shall include a local WSC man machine interface that permits complete operation of the WSC demand access equipment (including the DAP and DAB) from the WSC.	F	1.2.3.1	D
109	3.4.3	DA Planning Tool Function	The DA Planning Tool Function shall reside in the DA Users operations center.	A	N/A	I
110	3.4.3	DA Planning Tool Function	The Planning Tool shall provide the DAS User with information to make decisions about DA service availability.	F	1.1	D
111	3.4.3	DA Planning Tool Function	The Planning Tool shall provide a means of placing a DA scheduling request into the DAS.	F	1.0	D
112	4.1.1.1	User Planning Operations Perspective	The DAS User shall interact with the Planning Tool's Graphical User Interface (GUI) during the planning session phase.	F	1.1	A
113	4.1.1.1	User Planning Operations Perspective	At the most basic level of operations, the user shall be presented with the time slots that remain available on the TUT schedule which is updated daily by the NCC.	F	1.1	D
114	4.1.1.1	User Planning Operations Perspective	The user shall be able to vary the level of flexibility of the scheduling requests derived from planning information from a completely flexible to highly specific request for DAS services.	F	1.1	D
115	4.1.1.1	User Planning Operations Perspective	The amount of complexity associated with the planning request shall depend in general upon GUI flexibility.	F	1.1	D
116	4.1.1.1	User Planning Operations Perspective	The DAS User accepts any available TUT slots for the purpose of uploading buffered commands and data to the UP. In this situation the user provides commands and data for buffering but leaves it to the DAS to decide when the DAF service shall be established to upload the information to the UP.	F	1.1	D

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
117	4.1.1.1	User Planning Operations Perspective	A DAS User with dedicated DAR equipment shall request that a dedicated service be setup on a continuous basis to relay UP data to the user POCC.	O	N/A	D
118	4.1.1.1	User Planning Operations Perspective	The Planning Tool shall retain information that characterizes the routine operations of a DAS User. This information becomes a customized user service profile. The profile allows the user to set up requests rapidly while concentrating only on the parameters that change from each instantiation of the service request to the next. The configuration profile significantly reduces the amount of user/Planning Tool interactions for requests that occur frequently in the DAS User's operations repertoire.	F	1.1	T
119	3.4.2.3	DACDHS Function	Each implementation of the DAS SGLT shall contain an MMI that will be used to control the DAS equipment located at the SGLT.	F	1.2.3.1	D
120	4.1.1.2	System Planning Operations Perspective	The DAP processor shall automatically update the DAS database as updated spacecraft state vectors and TUT schedules are supplied from the FDF and NCC, respectively.	F	1.2.1.4	D
121	4.1.2	DAF Operations	DAF operations shall provide the DA User with a one-way open data communications channel from the user POCC to the UP.	O	N/A	D
122	4.1.2	DAF Operations	Two modes of operations shall exist for DAF operations. These modes are: • Instantaneous Command Mode – DAP passes through commands from the user POCC for uplink to the UP in real-time at the DAP • Delayed Command Mode – DAP buffers the commands provided by the user POCC for uplinking to the UP at a user specified time	O	N/A	D
123	4.1.3.1	Unlimited Operations	DAR Unlimited Operations shall provide the user with the capability of receiving data from its UP on a continuous basis as long as the platform is in view of a TDRS.	O	N/A	D

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
124	4.1.3.1	Unlimited Operations	Unlimited Operations shall support several operations modes. These modes are as follows: • Single UP Mode – Users that require long periods of time to return data from a single UP (balloon, aircraft, buoy, etc.) can use this unlimited DAR service scenario option provided that their DAR equipment and UPs meet the following constraints: - UP has a dedicated beamformer and demodulator at one GT - UP is in constant view of at least one TDRSS spacecraft • Multiple UP Mode – Users that require long periods of time to return data from multiple UPs (balloons, aircraft, buoys, etc.) can use this unlimited DAR service scenario option provided that their DAR equipment and UPs meet the following constraints: - UPs have a dedicated beamformer and multiple demodulators - UPs are in constant view of one TDRSS spacecraft • UP Handover Mode – Users with dedicated DAS equipment can schedule continuous MAR service support for USATs as these platforms circle the Earth provided that their DAR equipment and UPs meet the following constraints: - UPs have dedicated beamformers and demodulators at more than one SLGT (all SLGTs for a full orbit or more of continuous data) - UP is in constant view of at least one TDRSS spacecraft	O	N/A	D
125	4.1.3.1	Unlimited Operations	In order to terminate unlimited operation, the DA User shall use the termination mode of the DA Service Reconfiguration Operation described in the DASDOC.	O	N/A	D
126	4.1.3.2	Limited Operations	The objective of the DAR Limited Operations shall be to provide DA Users with the capability of scheduling limited amounts of predetermined return service time. These DA service contact opportunities are scheduled with known start and stop times. This operational scenario provides the DA Users with a simple and cost effective means of scheduling return service time windows for routine data return collection activities such as data dumps, etc.	O	N/A	D

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
127	4.1.3.3.1	Introduction to Polling Concepts	Polling is the sequential servicing of multiple UPs in the DAR service. This class of service shall be suitable for users who do not own, or wish to share, many sets of beamforming equipment. Essentially, one set of DAR equipment is periodically reconfigured so as to form an antenna beam on one of several UPs. For global coverage, it will be necessary to have three sets (one set per SGLT) of beamforming equipment: one in Guam, the other two at White Sands, NM (i.e., WSC).	O	N/A	D
128	4.1.3.3.2	Polling Operations	The objective of the Polling DAR Operations shall be to provide single DA Users with the capability of scanning a set of USATs controlled by the user POCC and locking onto USAT MAR signals that are encountered in the polling scenario.	O	N/A	D
129	4.1.4	DA Tracking Operations	DA tracking operations shall allow the FDF or DAS User to schedule one-way Doppler tracking services. One-way DAR tracking scenarios resemble one-way DAR scenarios with the addition of Tracking Data Messages (TDMs) being sent to the FDF or DAS User. In order to schedule the one-way Doppler return, the DAS User must have a dedicated demodulator with a Doppler extractor in order to make the Doppler measurement.	O	N/A	D
130	4.1.4	DA Tracking Operations	Two-way Doppler and range tracking services shall be available as DAS options. DAS requests for either of these services can result in the DAP requesting the NCC to set up the current MA tracking service option. Two-way range will not be supported directly by the DAS equipment. However, a second option exists for two-way Doppler. The two-way Doppler service can be established when the DAS User requests concurrent DA forward and return services while a dedicated demodulator with a Doppler extractor is assigned to the equipment chain.	F	1.2.1	D
131	4.1.5	DA Service Reconfiguration Operations	SROs shall provide both forward and return DAS User with the capability of changing a previously accepted operations request from the queue of scheduled or ongoing scenarios.	F	1.2	D

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
132	4.1.5	DA Service Reconfiguration Operations	SROs shall include the cancellation of a previously accepted request	F	1.2.1.1	D
133	4.1.5	DA Service Reconfiguration Operations	SROs shall include the lengthening or shortening of the duration of a request	F	1.2.1.1	D
134	4.1.5	DA Service Reconfiguration Operations	SROs shall include the termination of an operations scenario currently being executed	F	1.2.1.1	D
135	4.1.5	DA Service Reconfiguration Operations	SROs shall include the request for alternative equipment chains	F	1.2.1.1	D
136	4.1.5	DA Service Reconfiguration Operations	SROs shall include a change to the beamformer mode	F	1.2.1.1	D
137	4.1.5	DA Service Reconfiguration Operations	SRO shall occur before or during the execution of the existing user's operations request depending upon the nature of the reconfiguration results being sought by the user.	O	N/A	D
138	4.2	DA Background Operations Scenarios	Background operations shall support the overall operations of the DAS and are virtually transparent to DAS Users. The background operations scenarios represent DAS overhead operations that support the user scenarios with updated information for scheduling purposes.	O	N/A	D
139	4.2.1	TDRSS Unscheduled Time (TUT) Updates	TUT shall be determined by the NCC each day when the schedule for a ten-day window (starting on the current day) has been assessed. TUT represents all of the time on the NCC schedule when MAF and MAR services are not scheduled. Once the daily schedule update has been finalized, the NCC sends the DAS the TUT schedule for that ten day window. This message flow is currently implemented as an Internet e-mail transaction. The unscheduled MAF and MAR services become the DAF and DAR time slots that are presented to the DA Planning Tool for DA User scheduling opportunities.	O	N/A	I

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
140	4.2.2	State Vector (SV) Updates	The FDF computes the SVs of the UPs and TDRSS satellites for various purposes. This information shall be provided to the DAS as SV updates are available from the FDF.	O	N/A	D
141	4.2.3	DA Equipment Status Operations	The DAP shall constantly monitor the status of the DAS equipment by polling for and collecting status information from each of the DAS subsystems.	O	N/A	D
142	3.4.2.3	DACDHS Function	A Master DAS Operator at one WSC SGLT shall be able to test the DAS equipment at all the SGLTs.	F	1.2	D
143	3.4.2.3	DACDHS Function	The MMI at the WSC SGLT shall be the Master Control Console for initiating start up, configuration, test and termination operations for the DAS equipment at all DAS SGLT installations.	F	1.2.3.1	D
144	4.1.1.2	System Planning Operations Perspective	Upon receipt of the planning information, the Planning Tool shall be used to determine how the available time can be used to meet the DA scheduling objectives of the user.	F	1.1	D
145	4.1.3.3.1	Introduction to Polling Concepts	The beamformer and the acquisition time of the demodulator shall dictate the maximum polling update rate. The TGBFS beamformer will allow for one-second updates, and a typical demodulator will take a few seconds to acquire a signal.	O	N/A	D
146	4.1.3.3.1	Introduction to Polling Concepts	The DAR polling rate shall be user defined.	F	1.1	I
147	4.1.3.3.1	Introduction to Polling Concepts	In the event that a user satellite beacon is detected, the polling process shall stop and the DA service is now dedicated to that particular user satellite.	O	N/A	D
148	4.2.4	Contingency Operations	The DAS system shall allow for contingency operations such as non-user initiated DA service cancellations, acknowledgements of messages received, etc.	O	N/A	D
149	4.3	DAS Control Operations Scenarios	DAS Control Operations shall provide the Master DAS Operator located at one WSC SGLT MMI with the capability to start up, configure, terminate, and test the portion of the DAS system that is related to that particular SGLT.	F	1.0	D
150	4.3.1	DAS Start Up Operations	Start Up Operations shall provide the Master DAS Operator at one WSC SGLT with the capability of starting the DAS equipment at all the SLGTs.	O	N/A	D

Table 7-1 DAS Requirements Summary and Cross-Reference (Continued)

Req. No.	DASDOC Section No.	DASDOC Section Title	Requirements Extracted from DASDOC	Req. Type	Function ID	Test Type
151	4.3.2	DAS Configuration Operations	DAS Configuration Operations shall provide the Master DAS Operator with the capability to modify system configuration files to account for equipment added to or removed from the DAS.	O	N/A	D
152	4.3.3	DAS Test Operations	Test Operations shall provide the Master DAS Operator with the capability of testing the DAS equipment at each SGLT.	O	N/A	D
153	4.3.4	DAS Termination Operations	Termination Operations shall provide the Master DAS Operator with the capability of shutting down the DAS equipment at all SGLTs in an orderly fashion.	O	N/A	D
154	4.2.2	State Vector (SV) Updates	The SV updates shall be used by the DAS to calculate the periods of line-of-sight visibility between the user satellites and the TDRSs in order to support DA service schedule planning.	F	1.0	D

8. Abbreviations and Acronyms

DA	Demand Access
DAB	Demand Access Buffer
DACDHS	Demand Access Control Data Handling System
DAF	Demand Access Forward
DAP	Demand Access Processor
DAR	Demand Access Return
DARCM	Demand Access Return Control/Monitoring
DARCMS	Demand Access Return Control/Monitoring System
DAS	Demand Access System
DASDOC	Demand Access System Description and Operations Concept
DASICD	Demand Access System Interface Control Document
DASRS	Demand Access System Requirements Specification
DB	Database
DFD	Data Flow Diagram
GSFC	Goddard Space Flight Center
GT	Ground Terminal
GUI	Graphical User Interface
IF	Intermediate Frequency
IOnet	Input/Output network
IBU	Independent Beamformer Unit
MA	Multiple Access
MABE	Multiple Access Beamforming Equipment
MAF	Multiple Access Forward
MAR	Multiple Access Return
MMI	Man Machine Interface
NCC	Network Control Center
PN	Pseudorandom Noise
POCC	Project Operations Control Center
RF	Radio Frequency
RLDRS	Return Link Data Recovery Subsystem
SGL	Space Ground Link
SGLT	Space Ground Link Terminal
SHO	Schedule Request Order
SN	Space Network
SRO	Service Reconfiguration Operation
STDN	Space Flight Tracking and Data Network
SV	State Vector
TBD	To Be Determined
TDRS	Tracking and Data Relay Satellite
TDRSS	Tracking and Data Relay Satellite System
TGBFS	Third Generation Beamforming System
TUT	TDRS Unused Time
UP	User Platform
USAT	User Satellite
WSC	White Sands Complex